NATURE

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CONTENTS

	PAGE
Ideals in Africa	829
Prehistoric Crete. By Prof. John L. Myres, O.B.E.	831
Cultivated Poplars. By Dr. R. Melville	832
Progress in Physics	833
The Ganges Delta. By J. S. G.	834
The Phase Rule. By J. R. P.	835
The Drift of the *Sedov*. By Prof. N. N. Zubov	837
Medical Research in Great Britain	840
Observation of the Sun's Corona and Prominences without Eclipses	842
Obituary Notices:	
Miss M. F. Rich. By Prof. F. E. Fritsch, F.R.S.	845
Prof. I. M. Gubkin	845
News and Views	846
Letters to the Editor:	
Emission of Neutrons accompanying the Fission of Uranium Nuclei.—Dr. J. Rotblat	852
Statistical Calculation of Composite Decay Curves.—Dr. O. R. Frisch	852
Specific Heat of Copper Sulphate below 1° K.—J. Ashmead	853
Sparking Potential of Deuterium (Heavy Hydrogen).—Dr. F. Llewellyn Jones	854
Penetration of the Potential Barrier and Formation of AlH.—G. Stenvinkel	854
Stress Tensor and Particle Density in Special Relativity Theory.—Prof. D. van Dantzig	855
Motion of the Spiral Nebulæ.—Dr. Albert Eagle	856
Influence of Micelle Formation on Flotation.—Dr. E. E. Wark and Dr. I. W. Wark	856
Structure of Alginic Acid.—Prof. E. L. Hirst, F.R.S., J. K. N. Jones and Winifred O. Jones	857
Further Experiments on Homing in Storks.—Prof. Kazimierz Wodzicki, Wl. Puchalski and H. Liche	857
Hypospadias and Non-descent of the Testes caused in Rats by Progesterone.—Dr. Harold Burrows	858
New Data on Spontaneous Mutations.—J. M. Olenov	858
Centripetal Xylem in the Pedicel of a Monocotyledon.—Prof. A. C. Joshi	859
Ethmoplax, a New Name for *Stratiphyllum* Smyth.—Prof. Louis B. Smyth	859
Kinetochore or Centromere ?—Dr. Franz Schrader	860
Research Items	861
Relations of the Flora and Fauna of Ireland to those of other Countries	863
Medicine in the Renaissance. By Walter Bett	864
Soil Mechanics	865
University Events	866
Science News a Century Ago	866
Societies and Academies	867

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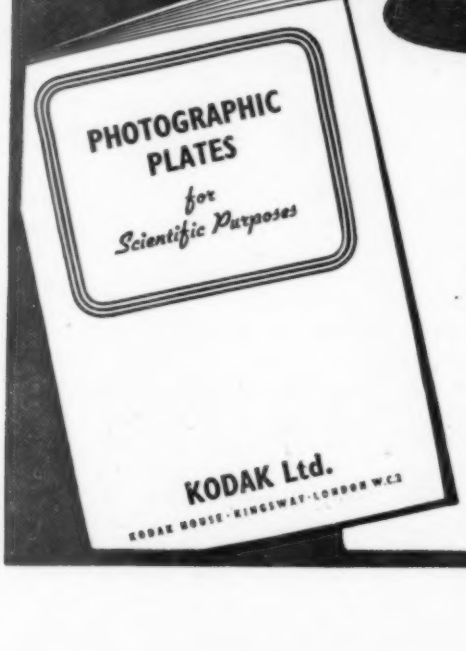

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Ideals in Africa*

ON March 9, 1938, H.M. the King appointed a Commission "to inquire and report whether any, and if so what, form of closer co-operation or association between Southern Rhodesia, Northern Rhodesia and Nyasaland is desirable and feasible". The Commissioners were five in number, of whom Viscount Bledisloe acted as chairman. After preliminary inquiry and the hearing of evidence in England, the Commission proceeded to Africa, arriving at Bulawayo on May 16. When evidence had been taken in Southern Rhodesia, the Commission visited Portuguese East Africa, passed on to Nyasaland and returned through Northern Rhodesia to Salisbury.

Taken together, the three territories which came under the purview of the Commission include an area of approximately 500,000 miles, with a total population estimated at roughly 4,300,000. Of these, approximately 68,000 are European, 8,000 are Asiatics and 'coloured' in the sense in which that term is used in southern Africa, namely, the offspring of union between non-native and native, and 4,230,000 are natives. The proportion of Europeans to natives in the combined territories is 1 to 62 ; but the ratio is more significant when the territories are distinguished : in Southern Rhodesia it is 1 to 22, in Northern Rhodesia 1 to 129 and in Nyasaland 1 to 881. While both European and native populations have increased between 1926 and 1936, the rise among Europeans has been relatively more rapid owing to the development of the copper mines. It shows a decrease in the later return owing to the interruption of development work in the mines ; but with the renewal of activity it is again increasing slowly.

It is especially important to bear these figures and their inter-relations in mind, in view of the conditions which were imposed on the inquiry of the Commission and its findings. In the Royal Warrant, it was specifically laid down that in reporting on the desirability and feasibility of co-operation or association between the territories, due regard was to be had to "the interests of all the inhabitants, irrespective of race . . . and to the special responsibility of Our government in the United Kingdom of Great Britain and Northern Ireland for the interests of the native inhabitants". As will appear, the members of the Commission, collectively and individually, have given full weight to this instruction. The manner in which they have discharged their obligation raises issues in native policy of the gravest importance, not only as affecting the territories immediately concerned, but also as touching the interests of all natives throughout British colonial possessions in Africa. Indeed it may not be without repercussion elsewhere, in territories other than British, should certain suggestions which arise out of the report be given practical effect.

Broadly speaking, the recommendations of the Commission do not favour the proposal of an amalgamation of the three territories, at any rate in the near future. While there is a suggestion that they may look forward ultimately to becoming one great united territory, which might well aspire to dominion status, the time for such a development is far from being yet. Certain suggestions are put forward as practicable, with the view of securing greater uniformity in administration, especially in finance and education, as well as affecting labour, while certain measures in what may be termed the machinery of government are

* Rhodesia—Nyasaland Royal Commission. Report. (Cmd. 5949.) Pp. x+283. (London : H.M. Stationery Office, 1939.) 7s. 6d. net.

adumbrated as likely to secure an even greater measure of association in organization and policy. On the whole, however, unless and until conditions change, the Commission is adverse from the close union, if not amalgamation, which for some time has been the subject of consideration and much discussion.

The report, in regard to its recommendations, is a document of singular interest. The main recommendation is, of course, unanimous; but in certain respects the report is exceptional. We are accustomed to reports of commissions in which the main recommendations are accompanied by a minority report; but a report in which each member of the commission, including the chairman with one other, makes what is virtually a minority report, is surely unusual. In fairness to the members, however, it must be stated that some of them add their individual statements with reluctance, and as a measure of self-protection lest silence should be misconstrued as complete acceptance.

The explanation of this remarkable position is that the circumstances with which the members of the Commission had to deal are of singular difficulty, even among matters of native policy in Africa. The crux of the situation is that of outlook in native policy. The difference between Southern Rhodesia and the two remaining territories of Northern Rhodesia and Nyasaland, which in this matter for practical purposes are at one, is so great, so fundamental, as to form an obstacle to amalgamation which in present circumstances is felt to be insuperable. In this the members of the Commission are agreed. Their differences lie in the degree to which they regard a measure of co-operation as immediately possible, and ultimate closer union as both practicable and desirable. At the same time, however, it is pointed out that native policy and the methods of native administration in all three territories are to a great extent still experimental; and it is by no means impossible that, as experience grows, modifications may be effected which will bring an outlook, at present diverse, into greater harmony.

In order to understand a situation which is regarded as of such gravity as to block a proposal which has much to recommend it in the many advantages, administrative, economic and financial, which would immediately accrue, especially to the less prosperous of the territories, it is perhaps necessary to recall that it is only within the last few years that certain important changes have been made in the principles and methods of native government in all three territories. While, however, in Northern Rhodesia and Nyasaland the principle of indirect rule has been applied with all that it involves in regard to the respect paid to native law and custom in matters affecting the natives—that is while, in the words of the White Paper which stands as a charter of the principles of British Colonial government, the interests of the natives are paramount—in Southern Rhodesia, where the lead of policy in the Union of South Africa has been followed, the principle of segregation has been applied, and in the enthusiasm of reform, it must be admitted with some rigour. Not only is segregation physical—not only are native lands inaccessible to Europeans, but also native ownership or occupation of European lands is forbidden—and the opportunities open to Europeans in the higher branches of education, in certain occupations, and so forth are debarred to all natives. In short, a 'colour bar' no less strong and no less rigid than that which exists under the Union has been instituted in Southern Rhodesia. The problem raised by this difference in outlook to some extent is aggravated in Northern Rhodesia by the difficulties which arise from the poverty of the people and overcrowding, in itself a consequence of the poverty, alleged to be irremediable, of large parts of their lands, as well as the special problem, which has already arisen through the development of industry, of the urbanized native—a problem which will require, but has still to receive, adequate special treatment.

A factor in the situation which should not be overlooked or underrated is the attitude of the natives themselves in both Rhodesia and Nyasaland. Their opposition is "unmistakable, pronounced and strikingly unanimous".

The position of Southern Rhodesia in following the lead of the Union, is, of course, one that is readily comprehensible, and to a great extent arises out of its history. Like the Union, its policy is based upon the ideal of a white civilization in a country that has been regarded as eminently suitable for remunerative and permanent white settlement with a white civilization as predominant, while its main preoccupation in domestic economy has been the provision of an adequate and readily available supply of labour. With such an outlook, Southern Rhodesia, being, as she would, the predominant partner in any amalgamation, many features in the present situation, which are not in the best interests of the natives of the other

two territories, might be rendered permanent, if not intensified. For example, much attention has been devoted to the question of the supply of labour, and the danger is stressed whereby it is feared that the native populations of these territories might become permanently no more than feeders of the labour supply.

The inquiries of the Commission have covered a wide field and the members have made full use of the labours of the numerous commissions and inquiries which have preceded them. They have taken a wide view of the departments of native life which they feel would be affected by the proposed changes in administration. They have, therefore, not hesitated to direct attention to matters affecting the development of the native in which they feel a progressive policy should now be applied, and in which rapid progress might be made by the measure of co-operation between the Rhodesias and Nyasaland which they recommend. Education, instruction in agriculture and technical training, instruction in the care of the soil and in hygiene and the principles of nutrition, the fostering of the development of the peasant farmer class, are some only of the fields to which they point as urgently requiring development.

Fundamentally, however, the importance of this report lies in the stress laid, unostentatiously but nevertheless with unmistakable strength, on the difference in outlook of what may be termed the two schools of native policy, segregation and indirect rule, taking the latter in a broad sense. This antinomy prompts inquiry whether the white peoples in exercising their rule over Africa, and accepting their responsibilities for the welfare of the African as they profess to do, have any clear idea of the end to which they are directing him in assuming that responsibility for his development. Is indirect rule, which rests upon native custom, unless we do it no more than lip service, likely to lead either to stagnation, or a masked tribal disintegration, or is segregation, which sets the bounds of native development and that not beyond his presumed powers, the choice of the better part?

Prehistoric Crete

The Archæology of Crete

An Introduction. By J. D. S. Pendlebury. (Methuen's Handbooks of Archæology.) Pp. xxxii + 400 + 43 plates. (London: Methuen and Co., Ltd., 1939.) 30*s*. net.

IT was in 1894 that Sir Arthur Evans made his first journey in Crete, and in 1899 that his excavation of Knossos commenced. His own account of "The Palace of Minos" began to appear in 1921 and was completed in 1936. From time to time others have tried to summarize both the progress of discovery in Crete and the general bearings of it on the prehistoric archæology of the Mediterranean. But Mr. Pendlebury's book is the first thorough and satisfactory account of the work of many travellers and excavators; his numerous maps show how vast an accumulation there has been of observations and finds, and the lists of sites appended to them how much he has himself contributed by persistent exploration, covering now every district of the island. As curator formerly of Knossos, where the Palace and its surroundings have been made over by Sir Arthur Evans to the British School of Archæology at Athens, he has not only written an invaluable "Handbook to the Palace", but has also himself examined and catalogued the stores of classified objects from every room and corridor, and from every stratum from the neolithic *tell* on which the Minoan settlements stand, to the sparse relics of classical antiquity, when the site had become a 'no-man's-land' in the outskirts of the Greek and Roman city. After directing excavations at Tell-el-Amarna, the Egyptian site most closely connected with Ægean peoples in the fourteenth century B.C., just after the fall of the 'Palace' regime, he has devoted himself to a series of small but most significant excavations in the Lasithi district of Crete itself, on sites ranging from the earliest human occupation to the turbulent age which intervenes between the latest Minoan and the earliest Hellenic periods. Here are, therefore, all the qualifications for an "Introduction", as the author modestly describes it, to the archæology of Crete.

The greater part of the book is inevitably concerned with archæological detail, most carefully selected, and clearly described; but it begins with a convenient retrospect of Cretan discoveries, and a presentation of the physical characteristics of Crete, and of the topography and routes,

ancient and modern, which show Mr. Pendlebury to be a worthy successor of Pashley, Spratt, and Raulin. Future travellers will value his personal estimates of distances, and of the practical utility of the more difficult tracks, especially in the western districts, which have been curiously neglected by travellers; though it has been left to Mr. Pendlebury to make it probable, by his closer examination, that there is not very much to find there; the reason, he thinks, being that, west of Mount Ida, the island was not only less well provided with cultivable lowlands, but also very densely forested.

Of the early inhabitants, it is here repeatedly insisted (pp. 61, 267) that they remained physically uniform throughout the Minoan age. This is, however, not in accord with the measurements of Duckworth, Hawes, and von Luschan, summarized by Sir Arthur Evans in the passage quoted by Mr. Pendlebury to support his contrary view; nor with his own derivation of early elements both of culture and of population from Anatolia (p. 53).

On more controversial points, Mr. Pendlebury presents fairly the evidence and arguments, and gives his own views cautiously; but where it is a matter of personal observation and long experience, he knows his own mind. On the disputed date of the 'Medallion Pithoi', he thinks they may have remained in vogue for long; and he emphasizes also on several occasions that objects that were durable as well as valuable, such as stone vessels, may well have endured for ages. On the relations between Crete and the Mainland, as to the building of cupola-tombs, he gives the Mainland priority; and his book was finished just too soon to note the newly discovered cupola-tomb of earlier date at Knossos, which negatives that hypothesis.

Most accounts of Cretan archæology stop short with the fall of Knossos about 1400 B.C., or treat what follows as an epilogue. Here, however, we have full and intimate description of the difficult and not very attractive sequel, when the natural resources of Crete attracted adventurers and eventually settlers from elsewhere, and therewith new elements of culture—iron, brooches, cremation—and a new æsthetic outlook, diverse expressions of which are the Idæan bronze-reliefs, and the fine geometrically painted pottery of Hellenic Knossos. Examples of both would have been welcome additions to the plates.

The general survey of Cretan prehistory, which follows the detailed account of successive periods, inevitably repeats many points; but it is very acceptable as a reasoned estimate of what was going on, in the arts and industries, and also in economic and social life. Mr. Pendlebury knows the Cretan countryside so well, that his reconstructions are often vivid and convincing: among revolutions in the superstructure, the fundamentals of Cretan life remaining essentially unaltered.

The fifty plates, from the author's own photographs, are extraordinarily good, and full of interest; and a word must be said in praise also of Mr. Pinion's distribution maps and the specimens of decorative design drawn by Miss Money Coutts. In a second edition—which there will surely be—would it be possible to include an orographic sketch map, with which to compare the distributions of sites and routes?

JOHN L. MYRES.

Cultivated Poplars

The Black Poplars and their Hybrids Cultivated in Britain

By G. S. Cansdale and Members of the Staff of the Imperial Forestry Institute. Pp. 52+1 plate. (Oxford: Imperial Forestry Institute, 1938.) 3*s*. 6*d*.

IN common with many other groups of cultivated plants, the poplars include a number of hybrid forms, intergrading to such an extent in their morphological characters as to create considerable difficulties in the recognition of the different sorts. These difficulties are enhanced by the variation of the foliage borne on the several kinds of shoot normally found on a tree. Nevertheless, the necessity for careful selection of material intended for identification has often been overlooked. The author of the work under review wisely limits his attention to the vigorous long shoots and to the short shoots that carry the bulk of the foliage. The leaf and stem characters are studied, and those of critical value selected for use in the preparation of a key to the species and hybrids cultivated in Britain. With a genus such as *Populus*, flowering before the leaves appear, it is advantageous for a key to be based on vegetative characters only, providing ease and accuracy of identification are not impaired. In a few cases, the relative times of foliation and sex are introduced to distinguish closely related hybrids; but on the

whole the key is particularly clear and easy to use, and will be appreciated by all who have to deal with this critical group.

The short critical descriptions of the species and hybrids are excellent, and together with notes on various points of interest, they occupy about a third of the book. The same praise cannot be extended to the treatment of the nomenclature. Although much of the existing confusion has been cleared up, it is most unfortunate that the author has misinterpreted the International Rules of Botanical Nomenclature with respect to hybrids; each segregate from the hybrid *Populus nigra* L. × *P. deltoides* Marshall is given a different binomial name. To comply with the rules, segregates of one hybrid should be given the status of varieties or forms under the oldest valid binomial applicable to the group. It is obvious that failure to observe this rule must result in the publication of numbers of invalid and unwanted combinations.

The book also contains a historical review of the literature on the black poplars, and a bibliography of the more important works on the genus.

R. MELVILLE.

Progress in Physics

Reports on Progress in Physics
Vol. 5. General Editor: Allan Ferguson. Pp. v+445. (London: Physical Society, 1939.) 20s. net.

THIS, the latest annual volume of progress reports sponsored by the Physical Society, is larger than any of its predecessors, and the editors' nets have been spread even more widely than heretofore. There are nineteen separate chapters, and of these general physics is divided into four sections (R. C. Brown on surface tension and Brownian motion, Cox on elasticity, and Goodeve on the viscosity of non-Newtonian fluids), and optics and spectroscopy have five sections each, specially edited by L. C. Martin and W. Jevons respectively. Atomic physics is represented by two sections, single scattering of elementary particles (Champion) and cosmic rays (Heitler). Skinner contributes a long article on the soft X-ray spectroscopy of the solid state, which might also be classified as atomic physics.

The longest individual report in this volume is that of Hartshorn on absolute electrical measurements. This, and the articles on sound (E. G. Richardson), heat (Powell) and quantum mechanics (Flint), are in the well-established tradition of these reports. Astbury's article on electric wave filters and Nunn May's on the mechanism of the Geiger counter are also in the tradition, though they reflect a little more strongly the tendency towards a somewhat increased degree of specialization. In view of the very wide scope of some of the earlier reports, this tendency is entirely natural and in no way undesirable.

Breaking entirely new ground, and reflecting the interests of many members of the Physical Society, are long reports on meteorology (Brunt) and astronomy (Crommelin), while Melville's article on plastics is the first in this series to deal specifically with industrial physics. Further, this volume appreciably widens the appeal of the series to the physical chemist. McBain and Mills contribute an article on the Gibbs adsorption theorem, and, as has already been noted, one of the sections of general physics is from the hand of a physical chemist. Again, Mott and Gurney's report on recent theories of the liquid state is of almost equal interest to pure physicists and physical chemists.

Again on new ground, Dr. Phyllis Tookey Kerridge contributes an interesting chapter on instrumental aids for defective hearing, in which stress is laid on the medical aspects of the problem, while Dr. Mayneord's article on the use of X-rays and γ-rays in medicine is largely concerned with the difficult and purely physical problem of the accurate and unambiguous specification and measurement of dosage.

Finally, Barton's report on the teaching of physics in schools will interest a very numerous class of readers. It has been evident for some time, in the pages of the *School Science Review* and elsewhere, that there is in Great Britain an able, as well as an enthusiastic, body of science teachers. In particular, the Science Masters' Association and the Association of Women Science Teachers are doing much to raise the standard of instruction in physics in the secondary and public schools. The subject is obviously of importance to university as well as to school teachers; and as the Physical Society includes many teachers of both these types, it was a particularly happy idea to requisition a report of this kind from a practising schoolmaster with strong views.

The short list of contents given above may serve two purposes. In the first place, it may give new readers some idea of the type of fare provided;

it may be taken as axiomatic that most readers who have already used the reports will automatically subscribe to the new volume. Secondly, the *embarras de richesse* so revealed may indicate clearly enough the impracticability of setting down, in any reasonably modest space, an adequate analysis of individual contributions to the volume. In brief, we have, as an assurance of the authoritative nature of the reports, the fact that every writer is an active worker in the field that he describes. Thus, in the chapter on optics, Prof. Martin himself deals with optical instruments; Hampton and Wheat, of Messrs. Chance, with optical glass manufacture; Selwyn, of the Kodak Research Laboratories, with the theory of photography; and W. D. Wright with television optics. The spectroscopy team is drawn from an even wider area—Shenstone (Princeton), Crawford (Toronto), Foster (McGill), Hunter (Greenwich) and Pearse (Imperial College), dealing respectively with atomic spectra, hyperfine structure, Stark effect and related phenomena, astronomical spectroscopy, and the spectra of the alkali-metal hydrides.

The fact that the articles are written by specialists is not, of course, one which calls for comment; it would in these days be much more surprising if the matter were ordered otherwise. What is rather to be noticed here is the extraordinarily high standard of readability of the articles. It has already been pointed out that the chapters differ appreciably in degree of specialization; but everywhere the specialist writers have succeeded admirably in writing for, and not ostentatiously down to, the general reader so that he, as well as the more directly interested researcher, may profit from these most valuable summaries. The general impression left by the reports is that, on the whole, the authors have rather enjoyed writing them. One guesses that each writer has been given a very free hand to deal with the subject in his own way; something of this has indeed been implied in the prefaces to volumes 4 and 5, and the reports have benefited largely from the application of this sound editorial precept, at the cost, possibly, of a relatively trivial loss of homogeneity.

Prof. A. Ferguson, who has, with apparently undiminishing zest, seen the first five volumes through the press, now passes the editorial work to another hand. He has given the series a magnificent start, and there is every reason to expect that it will continue to prosper under the direction of his successor, Mr. J. H. Awbery.

The Ganges Delta

The Changing Face of Bengal

A Study in Riverine Economy. By Prof. Radhakamal Mukerjee. (Calcutta University Readership Lectures). Pp. viii + 293 + 23 plates. (Calcutta: The University, 1938.)

THE problems of the Ganges delta are immeasurably more complicated than those of the Nile and Mississippi in that there are two mighty rivers, fed by heavy rains and melting snow, which carry maximal quantities of silt from the greatest of mountains into the head of a deep bay, not on to an open coast. Rivers in gorges, cut through the foothills, have by their silt formed broad alluvial plains. South, the Ganges and Brahmaputra now meet and, to a considerable degree, are at war with each other for right of way, their battles influenced by strong tidal flows. Modern changes in their deltas, which have become conjoined, are illustrated by a dozen maps dating from the sixteenth century, but the lack of a map showing existing conditions and settlements often embarrasses the reader. Even in this late historical period the population has more than doubled, 125 millions to-day, with a concentration which, in parts, equals that of the lower Yangtse. This has always been the richest agricultural area in India, and, as the author shows, the aim of invaders and the centre of a succession of empires. He indicates fluctuations in the sites of these, and ascribes them to the variation of the courses along which the rivers deposited their silt, particularly the gradual eastward movement of the delta. He foretells, in the not distant future, the necessary decay and abandonment of Calcutta, its water courses silted up, and its drainage impossible. It can only be saved by the further development of roads and railways; the embankments that such necessitate, have often been most damaging in hindering natural water movements, and hence producing miasmatic swamps.

An immense amount of work and a high standard of learning have been conjoined in these lectures; the facts are culled from many sources. Footnotes are useful, but great help will be given to the scientific reader by the considered bibliography. He may well desire to think more deeply of all the varied actions implied in delta formation, the

building of higher banks enclosing lower lands, the silting up of main water channels and in consequence their divergences, and finally the effects of these on agriculture and population. Rich and fertile rice marshes—often jute to-day—may dry up, and perhaps the silt underlying basins may shrink downwards, turning them into impossible swamps or jungle in which the tiger finds its home. History affords instances of the loss of many even great cities in such; their estuaries are to-day merely swamp flats. While there is always growth and reclamation seaward, the decay behind balances, and no settlement has proved permanent. Large areas have become malarious and have resulted in great migrations of a population made up of many ethnographic features, and, of course, with rival religions, for there was here a Mohammedan conquest. In the Yangtse region, which best compares, there is no such change, and stability is ensured by infanticide, which the psychology of the Ganges peoples does not encourage.

The footnotes provided by the author suggest that the Government is fully alive to all the difficulties which confront it, and which must remain with every Government. Prof. Mukerjee refers to agricultural deterioration and rural decay in large tracts of land, but he does not attempt to balance loss and gain—and we require more information on the economic results of irrigation along the upper courses of the rivers. He gives the impression of never having personally investigated the conditions of the delta, and he is not constructive in his suggestions. We are not convinced that his proposed "Ganges River Commission" will or can do more than is being already done, presumably by a corps of specialist officers. The conclusion forced on us by a study of this work is that any "co-ordinated policy of forest, soil and water management" depends on the complete harnessing and control of the Ganges and Brahmaputra, and that this, if attempted, is as likely to destroy as much as it conserves.

J. S. G.

The Phase Rule

(1) The Phase Rule and Phase Reactions: Theoretical and Practical

By Dr. Sydney T. Bowden. Pp. xviii+303. (London: Macmillan and Co., Ltd., 1938.) 10*s.* net.

(2) The Phase Rule and its Applications

By Prof. Alexander Findlay. Revised with the assistance of Prof. A. N. Campbell. (Textbooks on Physical Chemistry). Eighth edition. Pp. xv+327. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 12*s.* 6*d.* net.

(1) DR. BOWDEN'S book is an elementary introduction to the subject and is suitable for general B.Sc. students, many parts being adapted to teaching of intermediate standard. It contains numerous good laboratory experiments and there are collections of questions and examples, many taken from examination papers.

Special mention should be made of the illustrations, which are very clear and in many cases have been simplified so as to make them more intelligible to students beginning the subject. A notably good feature is the grouping of diagrams in the summaries; many students feel difficulty in co-ordinating the various parts of the subject, and this plan will be a very useful help. Another good feature is the inclusion of descriptions of structure as determined by X-ray and other methods, for example in the cases of the allotropy of sulphur, tin and iron. The contents include a good introduction to three-component systems, where the diagrams are very well chosen.

Although the book is intended to be elementary, the clearness of treatment will make it useful to more advanced students. The close relation to practical work tends to remove the rather abstract impression which most students get from a study of the phase rule. The book may be warmly recommended, and it is certain to be very popular both with teachers and students.

(2) Prof. Findlay's book is too well known to need description. It has established itself as the standard work on the subject and still remains the best introduction to the phase rule and its applications. The first part gives a very clear account of the fundamental principles, which is intelligible to students beginning the subject, and the general standard of the book is suitable for honours students.

The first edition of the book was published in 1904 and subsequent editions have left its main structure unchanged. It might be suggested that some sections could now be rewritten, and as examples those on the hydrogen-palladium system, liquid crystals and the iron-carbon system may be quoted. The book is assured of a continued and well-deserved popularity.

J. R. P.

(1) Alpine Flowers

36 Colour Plates from Watercolours specially prepared by Paul A. Robert. With Introductory Text by Prof. Dr. Carl Schroeter. (Art and Nature in Colour Series.) Pp. 12+36 plates. (London: B. T. Batsford, Ltd., 1938.) 10*s.* net.

(2) A Gallery of Gum Trees

By A. W. D'Ombrain. Pp. 54+21 plates. (London: H. K. Lewis and Co., Ltd., 1938.) 14*s.* 6*d.* net.

HERE are two beautiful examples of book production.

(1) The multi-coloured alpine flora of Switzerland lends itself easily to the painter in water-colours, and the many books printed and published in Switzerland containing reproductions of paintings of Swiss flowering plants are well known. Here we have thirty-six exquisite colour studies by Paul Robert reproduced by the world-famous 10-colour Iris Press of the Polygraphische Gesellschaft Laupen, Berne. These have been collected together and an introductory text has been written by none other than one of the greatest authorities on the Swiss alpine flora, Prof. Karl Schröter, who has recently died (NATURE, **143**, 365; 1939). Messrs. Batsford, the publishers of the English edition, are deserving of special commendation for offering this splendid collection at such a very modest price. The book is to be strongly recommended to botanists interested in alpine plants, artists, those interested in colour reproduction, and anyone keen on acquiring good books for his library.

(2) This descriptive collection of Australian gum trees is equally worthy of praise for its twenty-one beautiful coloured plates and good all-round production. It was set up and printed by the Australasian Medical Publishing Co., Ltd., which is to be congratulated on another real work of art. All the plates are reproductions of original paintings in water-colour executed by Miss Tydfyl Evans. Those living in Australia should have no difficulty in identifying any eucalypt if they have this book handy, and other botanists will get a very satisfactory idea of these peculiar trees from the text and illustrations. Any lover of a well-produced book, too, would consider himself fortunate in possessing a copy of this one.

A Monograph of the British Neuroptera

By Frederick James Killington. Vol. 2. (Ray Society Volume 123 for the Year 1936.) Pp. xii+306 +plates 16–30. (London: Bernard Quaritch, Ltd., 1937.) 25*s.*

THIS volume completes the author's account of the British Neuroptera. It is in every way up to the standard of volume 1, which was published in 1936 and has already been noticed in these columns. In volume 2 the subject-matter is concerned with the remainder of the family Hemerobiidæ together with the Chrysopidæ. Of the Heremerobiidæ it is noticed that the genus *Hemerobius*, as now understood, comprises eleven British species. Of the other genera of the family, *Boriomyia* with five British species, has undergone change of name. In the appendix to this volume the new genus *Kimminsia* is erected by the author to take its place. Of the rarer forms, *Megalomus* and *Drepanopteryx*, each with a single British species, are still comparatively little known. Some account of the metamorphosis of the first named is given, but as regards *Drepanopteryx* no progress has been made in our knowledge of its biology since a brief note by Standfuss published in 1910. Of the Chrysopidæ, fourteen British species are dealt with and these belong to the genera *Chrysopa* and *Nathanica*.

The volume is illustrated by fifteen plates (coloured and plain) and forty-seven text-figures. These are all well executed and reflect credit upon all concerned in their production. We congratulate Mr. Killington on the completion of a really excellent treatise.

A. D. I.

Plant Physiology

With Reference to the Green Plant. By Prof. Edwin C. Miller. (McGraw-Hill Publications in the Botanical Sciences.) Second edition. Pp. xxxi+1201. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 45*s.*

THE first edition of this very comprehensive textbook was favourably reviewed in NATURE of December 5, 1931, p. 952. In the second edition, about three hundred pages have been added and the price increased by ten shillings. This makes the price of the book rather excessive for the type of student for whom it is intended. All students reading for a university degree would find the book very useful, and research workers and other advanced students are offered an extensive bibliography at the end of each chapter. Subdivision of the text into large and small type will aid the student reading for a general degree. The questions inserted at the end of each chapter of the first edition have been omitted in this edition.

The whole text has been thoroughly revised and brought up to date, and much new material has been included.

Inorganic Colloid Chemistry

By Prof. Harry Boyer Weiser. Vol. 3: The Colloidal Salts. Pp. viii+473. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 30*s.* net.

THIS volume completes Prof. Weiser's treatise on inorganic colloid chemistry, and it is in every way a very satisfactory account of the subject with which it deals. The five parts treat of the colloid sulphates, halides, sulphides, ferro- and ferricyanides, and silicates. The treatment is essentially experimental, although the theories concerned receive adequate treatment. Full literature references are supplied. Among other general topics which come under review are the stability of sols and the mechanism of electrolyte coagulation, adsorption of ion lattices, adsorption indicators, the permeability of membranes, and the phenomena of thixotropy and rheopexy. Technical aspects receive careful attention.

The amount of information contained in the book is very large, yet the author has been able to produce a very readable text.

The Drift of the *Sedov**

By Prof. N. N. Zubov

THE scientific importance of the drift of the *Sedov* is comparable to that of the *Fram* or of the Papanin North-Polar Expedition on the drifting icefloe of 1937–38. Certain circumstances make the drift of the icebreaker specially interesting from a theoretical and practical point of view. First, the *Sedov*, together with the icebreakers *Sadko* and *Malygin*, began to drift in the Laptev Sea at lat. 75° 91′ N. and long. 132° 25′ E. on October 23, 1937, that is, while the Papanin Expedition was still working. Thus we have had the movement of the ice in the Arctic Basin under continuous observation since May 21, 1937, the date when the Papanin Expedition began its drift.

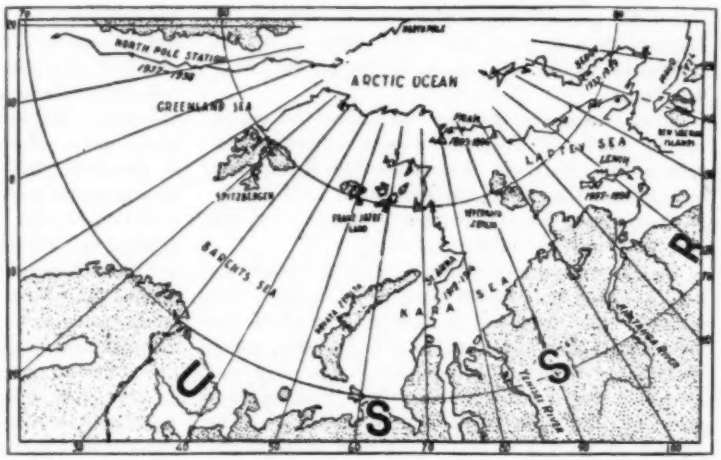
Secondly, a convoy of freighters, escorted by the icebreaker *Lenin*, was carried away by the ice from Khatanga Bay at the beginning of November, 1937, that is, soon after the commencement of the drift of the *Sadko*, *Malygin* and *Sedov*. These vessels drifted in the south-western part of the Laptev Sea until August 7, 1938, when they were freed by the icebreaker *Krassin*, which cut a passage through the ice.

Two groups of vessels were thus drifting with the ice simultaneously at some distance from each other for the space of nine months, one group in the south-western part of the Laptev Sea and the other in the north-eastern part of the same sea, north of the New Siberian Islands.

As is seen from the accompanying map, the drifts of the *Sedov* and the *Lenin* groups, although differing in detail, are remarkably similar. The *Sedov* is being carried approximately through the same region as Fridtjof Nansen's expedition of 1893–96 on the *Fram*.

A comparison of the drifts of the *Sedov* and the *Lenin* on one hand, and of those of the *Sedov* and the Papanin Expedition on the other, and finally a comparison of the drifts of the *Sedov* and the *Fram*, are of great scientific and practical value. The comparison of the drifts of the *Sedov* and the *Fram* is of particular interest because, as is known, climatic conditions have changed considerably since Nansen's time. As is evidenced by many facts, the atmosphere and hydrosphere in the Arctic have now become much warmer.

An examination of all the peculiar features of the *Sedov's* drift will only be possible after all the data collected have been carefully studied; but from data already available, it is possible even now to draw some important conclusions.



DRIFT OF THE *Fram*, *Sedov*, *Maud*, *Lenin*, *St. Anna* AND THE PAPANIN NORTH-POLAR EXPEDITION.

An important achievement of the *Sedov* has been the final destruction of the legend of 'Sannikov Land'. This alleged land derived its name from a Russian hunter named Sannikov who, in 1811, observed high land to the north of Kotelny Island but failed to reach it. Toll, a well-known Russian traveller, on the occasion of two visits to the New Siberian Islands made in 1886 and 1894, saw the land and even distinguished on it four high mountains, of which he drew the contours, and his guides, too, assured Toll that they had seen this land on more than one occasion.

Afterwards, several Arctic expeditions endeavoured to find this mysterious land. They were the 1900–3 expedition of the *Zarya* under

* The Soviet ice-breaker *Sedov* became ice-bound on October 23, 1937, in lat. 75° 21′ N., long. 132° 15′ E., near the New Siberian Islands. Attempts to free her last autumn failed, but some of her crew were exchanged with men from the rescue vessel *Ermack*. The *Sedov* is provisioned for several years and has fifteen men on board. On February 20, 1939, she was in lat. 86° 2′ N., long. 119° 5′ E., a little more than two hundred and fifty miles from the North Pole.

Toll, the expeditions of 1913 and 1914 on the icebreakers *Taimyr* and *Vaigach*, which discovered Severnaya Zemlya, and the Norwegian expedition on the *Maud* in 1924. 'Sannikov Land' was not sighted during any of these voyages, but this did not necessarily disprove its existence. None of the aforementioned vessels succeeded in going beyond the limits of the shallow waters of the continental shelf, while sailing north of the New Siberian Islands. So long as this shelf had not been adequately explored it was always possible that an island of continental origin might be found.

One of the objectives of the high latitude expedition on the icebreaker *Sadko* in 1937 was to search for 'Sannikov Land'. The *Sadko* on that occasion went northwards along the Kotelny Island meridian, and then eastward a little below the 78th parallel, approximately as far as the Bennett Island meridian. She then sailed to Henrietta Island. No trace of 'Sannikov Land' was found.

Now, during the drift of the *Sedov*, the region to the north of the New Siberian Islands was crossed on two more occasions—once from west to east and then from the south-east to the west. Moreover, the icebreaker has proceeded beyond the limits of the continental shelf.

The air expedition under A. Alexeyev made six flights across that region from Cape Kotelny last spring, when engaged in removing part of the crews from the *Sadko*, *Sedov* and *Malygin*, which were then still drifting together. Visibility was excellent on each occasion, but nothing was seen of the mysterious 'Sannikov Land'. The legend of 'Sannikov Land' has now been finally exploded.

The second important geographical achievement of the *Sedov* is her exploration of the continental shelf and the slope down to the great depths of the Arctic Ocean.

Prior to the Nansen expedition there was no knowledge of the central part of the Arctic Ocean. Soon after he entered the ice north-west of the New Siberian Islands, Nansen found a depth of 1,600 metres, approximately at lat. 78° N. and long. 134° E. A subsequent sounding taken approximately at lat. 80° 50′ N. and long. 126° E., showed the depth to be 3,850 metres, which was the deepest sounding taken by Nansen during his expedition.

These soundings established a deep-water basin. Hence, the determination of the boundaries of the continental shelf of the Arctic Ocean became one of the most important objectives of every expedition sent out to the central part of the Arctic.

The boundary of the continental shelf was established by the Papanin Expedition near the north-east coast of Greenland; by the expedition on the *Sadko* in 1935, near the northern part of the Kara Sea, where a sounding taken at lat. 82° 42′ N. and long. 87° 4′ E. showed a depth of 2,365 metres; and by the 1937 expedition of the *Sadko* in the Laptev Sea, where a sounding taken at lat. 77° 34′ N. and long. 118° 28′ E., showed a depth of 2,381 metres; and finally, during the drift of the *Sedov*.

The data obtained by the *Sedov* are very characteristic. The continental shelf in the region of the New Siberian Islands was shown to stretch farther north than had been supposed. Moreover, the continental slope proved exceedingly gradual; it stretches nearly 120 kilometres in a northerly direction, and its gradient is only between two and three degrees.

The observations carried out by the *Sedov* during her drift have made it possible once again to verify and to establish the fact that the direction and speed of the drift depend on the direction and velocity of the wind.

Like all previous drifts of icebound vessels and of the icefloe of the Papanin Expedition, the drift of the *Sedov* did not proceed in a straight line. The icebreaker quite frequently veered to one direction, turned back on her course, and described zigzags or even loops.

These changes in the direction of the drift are due to the changes of the wind, to which the ice-fields respond very rapidly. As Nansen had discovered and explained, the direction of the ice-drift in the central part of the Arctic Ocean, owing to the action of the deflecting force of the earth's rotation, deviates approximately 40° to the right from the direction of the wind blowing at a given moment over the ice. The speed of the drift is approximately one-fiftieth of the velocity of the wind. The *Sedov's* drift, too, has been subject to this law.

The accompanying diagram shows the remarkable similarity between the course of the wind and the course of the *Sedov*. Where the course of the wind is even, the drift proceeds approximately in the same direction, the only difference being that the drift is turned approximately 40° to the right. Where the wind changes sharply, the *Sedov*, too, begins to describe zigzags and loops. Very characteristic, in this respect, are the figures of eight described by the wind and the *Sedov* between October 2 and October 25 of last year, the zigzags between November 10 and November 30, 1938, and the loops between December 17, 1938, and January 17, 1939.

An examination of available data relating to the Central Polar Basin shows that there is either no constant current in the regions of the *Sedov* drift or, if such a current exists, it is so negligible as

scarcely to have any effect on the future movement of the vessel. Wind conditions will play the principal role.

The prevailing winds during the drift of the ice-breaker have been south-easterly. From September 1, 1938 to February 1, 1939, a moderate wind blew from the south-east at a velocity of about two metres per second. From this it follows that the *Sedov* is on the edge of a polar anti-cyclone, the centre of which is somewhere to the north-east of the vessel.

The *Sedov's* drift during the first half of last December was exceptional. At that time the vessel was under the influence of westerly and south-westerly winds. In other words, she was on the southern edge of cyclones sweeping into the central Arctic between her and the North Pole.

The North Polar Expedition of Papanin was the first to establish that these cyclones break through into the central part of the Arctic. However, they are much more likely to occur there in the first half of the winter than in the second. Hence, it may be presumed that the *Sedov* will not again be affected by such cyclones before the polar summer begins and that she will continue to drift in a north-north-westerly direction during the next two or three months.

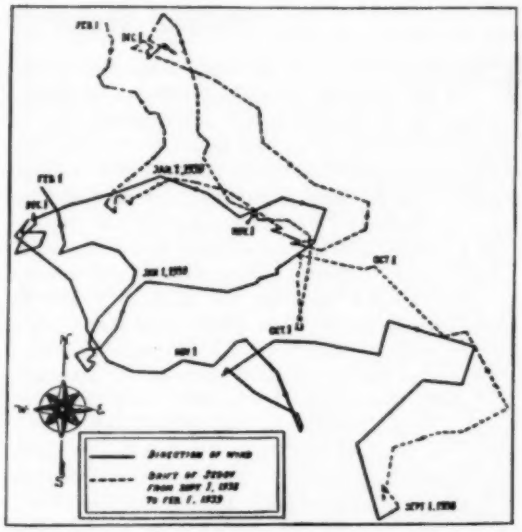
Owing to insufficient data, there is as yet no certainty as to the way in which the ice in the central part of the Arctic Ocean moves. Some Arctic explorers are of the opinion that in general the drift of the ice proceeds simply from the seas of the Soviet Arctic, first northward and then westward, to the strait between Greenland and Spitsbergen, and also from the shores of Alaska in a straight line across the North Pole to the Greenland Sea

The famous drifts of the *Jeannette* (1879–81), the *Fram* (1893–96), the *Karluk* (1913–14) and the *Maud* (1922–24), which took place near the continental slope in the central Arctic, are confirmation of this view. The way in which the icefloe of the Papanin North Polar Expedition (1937–38) was carried almost in a straight line from the Pole to the north-eastern coast of Greenland also fitted in with this view.

However, from the time of Toll's expedition of 1900–3, a theory has existed that besides the general movement of the ice from east to west, under the influence of a given system of winds there is a circular movement of the ice in a clockwise direction. This movement is supposed to have its centre near the 'pole of inaccessibility', which is situated between lat. 83° and 85° N., approximately on the meridian of Bering Strait.

Should this theory be correct, it is possible, judging from the direction of the wind and the drift, that the *Sedov* will later be drawn into a vast anti-cyclone and, consequently, into a circular movement around the 'pole of inaccessibility'. If this happens, the vessel will find herself after some time in the region between the North Pole and Bering Strait.

It may be assumed that the icefloe of the Papanin North Polar Expedition during its drift was on the eastern edge of the Greenland area of high atmospheric pressure and on the western boundary of the trough of low pressure created as a result of Atlantic cyclones breaking through into the Arctic. The *Sedov*, it seems, is on the western edge of the North American area of high pressure and on the eastern boundary of the trough of low pressure passing through the Arctic in the vicinity of the North Pole.



DIRECTION OF WIND AND DRIFT OF *Sedov* COMPARED.

The low figure obtained for the speed of the constant current by a study of the *Sedov's* drift does not seem to contradict these suppositions. Occasional but strong winds in one or other direction may draw the *Sedov* either into a drift similar to that of the Papanin icefloe or into a drift around the 'pole of inaccessibility'. This view was expressed by the present writer as early as the beginning of last December, and the data so far received from the vessel do not contradict it.

Another circumstance must be taken into account in connexion with these suppositions. The ice around the *Sedov* differs appreciably in its nature and movement from that observed by Soviet airmen at the North Pole. The vessel is surrounded by comparatively young ice (about two

or three years old), small fields with a considerable quantity of hummocky ice prevailing. In the region of the North Pole, old comparatively level fields were the most common. At least a year or more is necessary for the *Sedov* ice to be transformed into fields of this kind.

When flying from Franz Josef Land to the North Pole, the Soviet airmen first saw a belt of comparatively young ice. This was followed near lat. 86° N. by a peculiar belt of hummocky or jagged ice, the origin of which has not been sufficiently studied. Level fields of old ice stretched beyond this belt to the Pole itself.

To judge by the data at our disposal, the *Sedov* is in the belt of hummocky ice situated between the main mass of Arctic ice and the ice carried comparatively recently into the central basin from the seas of the Soviet Arctic. This would explain the constant movement and jamming of the ice observed by the *Sedov* expedition.

Finally, it is possible that the belt of hummocked ice stretches along the trough of low pressure created by the inrush of masses of Atlantic air into the Arctic. This is all the more probable since the passage of this air is usually accompanied by powerful winds.

Medical Research in Great Britain

FOR those who desire to obtain some conception of the progress of medical research in Great Britain, no better means can be suggested than a perusal of the latest annual report of the Medical Research Council*. Subjects to which the Council wishes to direct special attention are reviewed in the introduction; the remainder of the report falls naturally into several sections describing work carried out for different Government Departments, at the National Institute for Medical Research (including the Department of Biological Standards), by members of the Council's external scientific staff, and in clinical research units and in hospitals and other institutions by investigators aided by grants. The Council also awards research fellowships in tropical medicine, Rockefeller medical fellowships and Dorothy Temple Cross research fellowships in tuberculosis. During the year, Prof. A. J. Clark and Sir John Ledingham retired from the Council and Prof. C. R. Harington and Prof. W. W. C. Topley were appointed to succeed them.

The report mentions that a beginning has been made with the work of construction of the new National Institute for Medical Research at Mill Hill, to which reference was made in last year's report. At least two years, however, will be required for completion. The new Institute will provide accommodation for the central laboratory under the national scheme for research in chemotherapy, of which an account was also given last year. At present, research work is being gradually developed by selected investigators at different centres, the Council having assumed responsibility for supporting the chemical as well as the biological investigations: previously the former were supported by the Department of Scientific and Industrial Research. The policy of transferring the Institute to Mill Hill has involved reconsideration of the proposed memorial to the late Sir Walter Fletcher. The original intention was to apply the balance of the fund, after providing the personal memorial, towards a new laboratory for research on nutrition at Mill Hill. With the transference of the Institute, this laboratory, instead of being the chief building on the site, will occupy only a relatively subordinate position. It has been decided, therefore, with the agreement of the subscribers to the fund, to devote it to the provision of a hall for meetings and lectures as an addition to the new Institute. The Council will meet the whole cost of the nutrition laboratory.

The Council points out that, during the past twenty-five years, since the Medical Research Committee was first set up, there has been a great increase in knowledge of the body in health and disease, greater even than that of the previous twenty-five years. This new knowledge has had two influences which, in their effect on medical practice, are often opposed to each other. In the first place it has resulted in a great improvement in methods of diagnosis and treatment of disease, which has involved a vast increase in medical services. Many patients suffering from diseases which, twenty-five years ago, were incurable and uncontrollable can now be restored to health and well-being. At the same time new knowledge of curative treatment may in itself also bring about reduction in incidence of disease; for example, the more rapid and effective cure of gonorrhœa by drugs of the sulphanilamide group should result in a reduction in its incidence by reducing the spread of the infection. Recent results also give hope that these drugs may lead to reduction of the number of cases of middle ear disease, which is responsible for a large proportion of the cases of disabling deafness in Great Britain.

* Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1937–38. (Cmd. 5939.) Pp. 221. (London: H.M. Stationery Office, 1939.) 3s. 6d. net.

On the other hand, medical research has brought another kind of knowledge which, properly used, leads directly to the prevention and elimination of disease. The effect on medical practice is clearly opposed to the first-mentioned effect, since, by eliminating disease, it tends to reduce the needs for curative aids. The report points out that there is often great delay in bringing about the application of new discoveries to preventive ends. Fresh means of curative treatment, on the other hand, are generally applied within a short period of their discovery. This delay is considered to be due to the fact that there is no means of educating the public in the established advances in preventive medicine. It is responsible for much unnecessary suffering. The report illustrates this point by reference to the prevention of diphtheria and to the value of improved nutrition. Where preventive inoculation with diphtheria toxoid has been generally adopted, diphtheria as a clinical entity has practically disappeared: yet in 1937 there were more than 61,000 cases in England and Wales, with almost 3,000 deaths. The report urges parents to demand this prophylactic inoculation for their children, and considers that there is no doubt that its general adoption would lead to the virtual disappearance of the disease from Great Britain.

The need for improved nutrition has been discussed in previous reports, but the adoption of modern teaching in the subject is still depressingly slow: a much greater consumption of milk and other dairy products, of eggs, vegetables and fruit and of fat fish at the expense of bread, biscuits, sugar and sweets, will improve the physique of the people, reduce the amount of dental decay and greatly raise the standard of health. An increased consumption of the 'protective' foods would also be of great economic value to the country.

The Council is sometimes asked what is its policy in promoting research: whether it favours research on disease itself rather than on more academic problems of physiology and biochemistry. The general answer is that it welcomes both kinds of investigation. Promotion of specific research by the Council is usually done by appointment of individuals to its permanent staff, the choice depending on the subject which seems to require special attention and the merits of the person chosen. Thereafter the individual has wide liberty of action in planning investigation. The Council seldom chooses particular diseases for investigation; generally the choice is of a wider nature, to include study of an etiological factor common to a group of diseases, or a type of treatment of wide application; in fact, such subjects as virus diseases, endocrinology or chemotherapy. For another large part of the work helped by the Council by means of personal and expenses grants, the initiative in choice of subject and method of investigation lies with the head of the laboratory in respect of some individual worker, or with the worker himself. The Council considers that at the present time there is a relatively great dearth of work in clinical science and in experimental pathology, so that it is offering scholarships and fellowships to attract young investigators into these particular fields of inquiry.

An important duty of the Council is to help Government departments confronted with immediate problems of health and disease in the course of their work. The report describes briefly some of the main investigations now being made. Important research on nutrition in the Colonial Empire has been carried out in association with the Colonial Office. In Nyasaland, the dietetic and nutritional conditions of the people are being accurately assessed and related to other surveys of the agricultural and social conditions. It is hoped thereby to determine methods of producing those agricultural products which will cause a great improvement in the physical condition of the population. It is also hoped that this survey may form a model for many similar studies elsewhere in the Colonial territories. Other investigations made for Government departments relate to the nature and causes of chronic lung disease in coal miners, and to the dangers to health which may follow the use of certain organic substances as solvents in industry. Research has been made into the best methods of ridding houses of the bed-bug; it is hoped by this work to discover new insecticides for the purpose which are rapid in action, safe and cheap; good results have already been reported from fumigation with heavy naphtha.

The report describes results obtained in the treatment of cancer of the mouth, tongue, pharynx and larynx by radium beam therapy; most of the patients have been in an advanced and inoperable stage of cancer, but the results appear to compare favourably with those to be expected from surgery. Of even greater importance than the actual therapeutic results are the new technical methods which have been elaborated as the result of close co-operation between physicists and clinicians: they are already being widely used as models to be followed in researches in radiotherapy at other centres.

For the student of medicine and the specialist, the descriptions of recent researches on the hormones, the vitamins and virus diseases should prove of particular interest. It is pointed out that as a result of intensive chemical researches in the last few years, new synthetic substances having actions closely simulating those of some of the

natural hormones have been produced in the laboratory and made available for the treatment of disease. Thus diethylstilbœstrol is a synthetic œstrogen which is active by mouth and is already finding a place in treatment. A lengthy account of the physiological action of different hormones is given in the section of the report devoted to work carried out at the National Institute.

This summary is intended only to give a general idea of the work and policy of the Medical Research Council: brief reference has also been made to a few subjects in which there have been recent advances in knowledge. The interested reader will find in the report full references to all the researches carried out under the auspices of the Council which have been published in the scientific journals, as well as mention of the many investigations still in progress.

Observation of the Sun's Corona and Prominences without Eclipses

M. BERNARD LYOT, of the Astrophysical Section of the Paris Observatory, delivered the George Darwin Lecture before the Royal Astronomical Society on May 12, the subject being "A Study of the Solar Corona and Prominences without Eclipses". To this research, M. Lyot has made unique and fundamental contributions for which he has been awarded this year the Royal Astronomical Society's Gold Medal. The presentation of the Medal was made prior to the lecture by the president of the Society, Prof. H. C. Plummer, who spoke of the medallist's great achievement in recording for the first time the sun's corona without an eclipse.

M. Lyot began his lecture with a brief review of past attempts made by various investigators from 1878 onwards to record the solar corona without a total eclipse of the sun. Direct photography from high altitude sites, thermo-electric, spectroscopic and polariscopic methods had all been tried but gave negative results. In consequence, the problem was generally regarded as being beyond the range of observational technique. Ten years ago, M. Lyot, encouraged by the advice of the late Prof. H. O. Barnard of the Colombo Observatory, made a fresh attempt to record the corona in full sunlight.

Measurements made during total solar eclipses showed that the brightness of the corona at 2′ from the sun's edge was only about one-millionth that of the light from the disk. To obtain any success, it was therefore a primary necessity to reduce to a negligible amount the diffusion of light by the optical train of the telescope. This diffused light in an ordinary telescope is at least two hundred times greater than the inner coronal image. Furthermore, the whitish aureole of diffracted light around the sun produced by dust in the earth's lowest atmosphere and by ice crystals of cirrus cloud is generally in itself more than a hundred times brighter than the corona.

To overcome the first difficulty, M. Lyot constructed with increasing success three special coronographs. To avoid the dust, he took his apparatus to the Pic du Midi in the Pyrenees at a height of 2,870 metres, where excellent conditions on cloudless days are obtained, especially in the late spring.

The general plan on which the coronographs were constructed is as follows: A single plano-convex lens (A)* forms an image of the sun on a blackened disk of brass projecting just beyond the image by 15″–20″. A field lens placed behind the disk produces an image of the lens A in a diaphragm, the edge of which intercepts the light diffracted by A. A small screen placed in the centre of the diaphragm intercepts the light of the solar image produced by reflection from the surfaces of A. Behind the diaphragm and the screen, protected from the diffused light, an over-corrected objective forms an achromatic image of the corona on the plate. The whole optical train is contained in a tube, open only during the observations and coated inside with thick oil to trap the particles of dust. The primary lens must be wiped frequently with particular care.

M. Lyot showed a number of slides of the observatory and instruments. Even under the best conditions, the last part of the ascent of the Pic du Midi has to be made on foot. The coronographs are made to telescope into sections for manual transport often over deep snow.

THE CORONA: DIRECT PHOTOGRAPHS

Lyot's work on the direct photography of the corona was made in two stages: (1) 1930–34, when the new method by his coronographs was being

* The two later objectives were cut from flawless disks of borosilicate crown glass produced by Messrs. Parra-Mantois. The lens of the second coronograph was ground in the Institut d'Optique in Paris, while that of the third instrument was figured by M. Couder at the Paris Observatory.

tested; (2) after 1934, when new results were attempted. The first positive result was obtained on July 25, 1930, with his coronograph of 8 cm. aperture (stopped down to 3 cm.) and 2 metres in focal length. Using a red colour-filter, prominences were easily seen. The sun's image was surrounded by a slight halo without detail. Polarimeter tests showed the light of this halo to be polarized in a radial plane like the corona as observed at total eclipses but less strongly. The measures, in point of fact, indicated that one fifth of the light of this halo belonged to the corona, the remainder being due to diffusion. But there was other evidence to prove that Lyot had in reality isolated the sun's inner corona. On July 30 and the following days, an attached spectroscope showed amongst the absorption lines due to diffused solar light, an emission line in the green the wave-length of which to within one angstrom was the same as that of the well-known coronal line, λ 5303. The red coronal line, λ 6374, was also faintly visible.

A year later, a larger and more perfect coronograph (13 cm. in aperture and a focal length of 3·15 metres) had been constructed and transported with accessory apparatus to the Pic du Midi. With this instrument the first direct photograph of the sun's corona was obtained on July 21, 1931. This photograph and others exhibited on the screen showed the distinctive features of the inner corona as photographed at total eclipses—luminous arches, dark spaces, fine jets of coronal matter, etc. Changes of structure were also apparent within 24 hours. To this coronograph was attached a spectroheliograph, isolating a part of the spectrum 10 A. wide containing the green line 5303. Thus the distribution and strength of this coronal line all around the sun could be studied.

Slides of the earliest direct photographs of the corona had to be made by successive copying on the same plate, and in exact superposition, of the six best of twelve negatives taken in succession on any one day, the coronograph being turned on its axis through 30° between each exposure. This procedure diminished considerably the effect of spots produced by dust particles deposited on the second lens of the coronograph. In 1938, a rotatory mechanism was added to the latest of Lyot's coronographs (20 cm. in aperture and 4 metres in focal length) which annuls the effect of dust particles on the lens. A single negative is sufficient to gain a good picture of the corona (on a scale of 65 mm. to the solar diameter) with an exposure as short as seven seconds.

Among the many slides shown by M. Lyot to illustrate the delicate, complex structure of the inner corona and its changes, were some taken on May 11, 1937, when Mercury passed close to the sun's disk. At 10h. 10m., when the planet was only 1′ 11″ from the sun's edge, it was seen projected against a prominence. Later, at 11h. 14m., when at a distance of 2′ 37″, it was outlined against the corona itself; the sky then clouded.

The Coronal Spectrum

New and powerful spectrographs were devised by Lyot to be used with his two latest coronographs, and with these the spectrum of the corona has been explored from 3350 A. (the limit of the transparency of the coronographs) to 1200 A., which represents the limit of the sensitivity of the plates. To compass this range of spectrum, seven different kinds of plates had to be used, with exposures ranging from 10 minutes in the visible spectrum to 4 hours in the infra-red. M. Lyot then proceeded to show examples of the two hundred or so spectra which he has obtained up to the present time. The slit of the spectrograph is in the form of an arc crossing the east and west sides of the corona about 40″ from the sun's edge between latitudes ± 70°. These spectra, usually on a scale of 5–7½ A. per mm., show in addition to a continuous spectrum from the corona (and also the spectra of any prominences present), eleven coronal emission lines of which five are new lines not previously recorded under conditions of total solar eclipse. These emission lines are as follows, the new lines being indicated by an asterisk:

3388 A.	7060 A.* †
5116	7892
5303	8024*
5694*	10747*
6374	10798*
6702	

† Found later by Menzel on spectrograms taken at the eclipse of 1936.

The wave-length of the fourth and seventh lines listed are given more exactly as 5694·42 A. and 7059·62 A.

A notable feature of all the coronal lines shown is their great width. Allowing for instrumental corrections, their average widths are 0·8 A. in the green, 0·9–1·0 A. in the red, and greater than 1 A. in the infra-red. The distribution of these lines around the sun show differences from one another which are being studied. As an example, M. Lyot cited the curious distribution of λ 5694, which is invisible where λ 5303 is at a maximum. Another anomaly is the absence from the above list of the line λ 5536, of which no trace appeared on spectrograms taken in 1936, 1937 and 1938 under very favourable conditions and high solar activity. Perhaps the line does not extend to 40″ above the sun's limb like the other lines. Lyot considers

that the eleven lines listed fall into three groups : (*a*) λλ 5303, 3388, 5116, 6702, 7059, 8024, and probably 10747 and 10798 ; (*b*) 5694 ; (*c*) 6374 and 7892.

By measuring the differential Doppler effect given by the strong emission line, 5303 A., at the east and west edges of the sun, it is found that the corona rotates in the same sense as the general body of the sun and at approximately the same rate.

Spectra of Prominences

Some of the Pic du Midi spectrograms are very rich in lines from the spectra of prominences. The hydrogen spectrum was shown represented by the Paschen series (from the 6th term at 10939 A. to the 31st term, and the Balmer series in the ultra-violet from the 8th also to the 31st term. The lines of the Paschen series are much fainter than those of the Balmer series, but the atmospheric diffusion, greatly reduced in the infra-red, allows spectra of the Paschen series to be obtained easily without an eclipse.

Prominences Through Colour Filters

The continuous spectrum of prominences has been observed during eclipses, but it was thought that the spectrum was emitted only by some particular parts of the most intense prominences. To test this, three filters were used transmitting (*a*) continuous spectrum from 6100 A. to 6400 A. ; (*b*) the D_3 line of helium ; (*c*) $H\lambda$ of hydrogen. It was seen that (*a*) and (*b*) gave identical pictures both with respect to form and relative intensities. These results, taken in conjunction with polarization measurements, indicate that this continuous spectrum comes from all parts of a prominence, and in the visible range would appear to be due to the diffusion of the sun's light by the electrons that they contain.

Movements of Prominences

Lyot's coronograph, supplied with a filter isolating the line $H\lambda$, shows the prominences with great brilliancy against a very dark sky, and their faintest details appear. Since 1935, the movements of stable and eruptive prominences have been recorded at the Pic du Midi on cinematograph films, usually at a rate of two per minute and, in projection, speeded up 600 times. The height of the pictures which M. Lyot showed usually represented about 380,000 km., that is the distance of the moon from the earth, or thirty times the earth's diameter. These gave an extraordinary exhibition of prominence movements, of which a few examples may be outlined :

(1) Filaments fading away as they rise and brightening again as they fall back into the sun with a speed of 180 km./sec.

(2) A suspended cloud pours luminous material inwards to the chromosphere.

(3) A fountain-like prominence is suddenly thrown up by an explosion.

(4) A particularly stable prominence ; small internal motions are, however, perceptible. After many hours, part of the cloud becomes very bright. A chromospheric eruption leaves the sun at the speed of 700 km. per sec. and cuts the prominence into two parts. The luminous mass, its equilibrium lost, flows into the sun and seems to flow around an invisible obstacle.

(5) A prominence similar to those called "coronal prominences" by Pettit and McMath. Material, originating in invisible clouds, flows downwards on both sides of a loop or arch into the chromosphere.

In conclusion, M. Lyot said that it would be very interesting to compare the observations of the corona by both methods—with and without eclipses. The outer parts of the corona can be obtained only during eclipses ; the new method without an eclipse shows only the inner corona, but daily or even hourly variations of the corona can be recorded. With regard to the coronal spectrum ; in the ultra-violet, the violet and the blue, the atmospheric diffusion is very strong, and the new method is in consequence very inferior to the old method. In the green, the diffusion is less strong, and its effects can be diminished by increasing the dispersion and making longer exposures. By choosing days on which the corona is intense, the faint coronal lines appear. The numerous spectrograms on a large scale, possible with the new method, enable the lines to be distinguished from the agglomerations of grains on the plate, and their wave-lengths are measurable with great precision. In the infra-red the new method is superior.

For studying prominences, the extra-eclipse method alone enables the solar observer to wait for the appearance of very bright objects having the richest and most interesting spectra. Observations made without eclipses can therefore not replace the work of expeditions investigating total eclipse phenomena, but the two methods complement one another in numerous ways, and their simultaneous use would increase our knowledge more rapidly of the sun's outer atmosphere.

Obituary Notices

Miss M. F. Rich

BY the death on April 20 at Ruislip, Middlesex, of Mary Florence Rich, botanical science has lost an active and enthusiastic contributor to our knowledge of freshwater algæ. Born at Weston-super-Mare in 1865 and educated at Aske's School, Hatcham, Miss Rich studied at Somerville College, Oxford, where she held a Clothworkers' scholarship. Taking up the teaching profession she held for some years a post at Roedean and then established a girls' school (Granville School) at Leicester, which acquired a considerable reputation and which she continued to direct until 1923.

Although not primarily trained as a botanist, Miss Rich had already so far back as 1903 taken up the study of freshwater algæ, to which she devoted a considerable amount of her leisure time while she was at Leicester. During this period she published with me a series of papers on the periodicity of these forms and also compiled a valuable list of the algæ of Leicestershire. After her retirement from scholastic work, she devoted the remaining years of her life to algal work, settling in the Department of Botany, Queen Mary College (then East London College), in which she afterwards held the position of honorary research assistant. As witness to her activity during these last fifteen years of her life, we have a long series of taxonomic papers, largely dealing with the freshwater algæ of Africa, including the phytoplankton of the Rift Valley lakes in Kenya and that collected by the Cambridge Expedition to the East African lakes. Many of the research workers in the Department owed much to her kindly help and her keen interest in any work that was in progress. In recognition of her services she was made a fellow of Queen Mary College in December last. She was elected a fellow of the Linnean Society in 1926.

F. E. FRITSCH.

Prof. I. M. Gubkin

SOVIET science has sustained a great loss in the death on April 21 of Prof. I. M. Gubkin, the oil geologist, known not only in the U.S.S.R. but also to geologists throughout the world.

Born in 1871 of poor peasant parentage and acquiring an education with difficulty, Gubkin, though early interested in geology, was compelled to spend some years in teaching before he managed, at the age of thirty-two years, to enter the Mining Institute, where even as a student he attained distinction for original work.

He had made a study of the oil deposits of Maikop, Kuban and the Taman Peninsula, adjoining the Caucasus, and later of the Apsheron Peninsula, where he determined the stratigraphy and tectonics of the oil layers. In 1917, he was sent on a commission to the United States to study oil deposits of various ages and methods of their prospecting.

After the revolution, Gubkin organized the Soviet slate industry, became chairman of the council of the oil industry, and later, in the region of the Kursk magnetic anomaly, directed the boring operations which led to the discovery of big deposits of iron ore at a depth of 200–300 metres from the surface.

Gubkin was the first professor of the geology of oil deposits at the Moscow Mining Institute, of which he afterwards became the rector. He founded the Institute of Research in Petroleum, of which he was the head for a long time. He gave courses of lectures on the geology of world and Soviet oil deposits, creating a school of numerous pupils now engaged in studying and prospecting for oil on the territory of the U.S.S.R.

In 1929, Gubkin was elected a member of the Academy of Sciences of the U.S.S.R. In the Academy he founded the Institute of Combustible Minerals, of which he became the head. He was elected vice-president of the Academy in 1936. In 1933, he headed the Soviet delegation to the Geological Congress at Washington, and in 1937 he presided at the International Geological Congress in Moscow, where he read a paper on the oil reserves of the Soviet Union which, largely as the result of his own work in the discovery of new deposits, had been increased by several times during the period of the Soviet regime.

As head of the Geological Department, Prof. Gubkin directed work in the study of geological formations in the Soviet Union and the compilation of geological maps of the country. He was the author of a hundred and fifty scientific works. One completed not long before his death is entitled "Estimated Oil Reserves of the Soviet Union".

PROF. JOSEPH KLOBOUČEK, a distinguished Czech mathematician, died in Prague on April 18 at the age of sixty-four after a long illness which had necessitated his retirement early last year. He studied at the Universities of Turin and Milan but graduated at Prague, and before obtaining a professorship in 1919 had taught mathematics and science in secondary schools. He was a member of many Continental scientific societies and had contributed a number of papers, mainly on analytical geometry, to Czech and other periodicals.

WE regret to announce the death of Prof. Edward A. Burt, professor of botany in the Henry Shaw School of Botany in the University of Washington during 1913–25. He was an authority on the morphology and physiology of the Basidiomycetes.

News and Views

Dr. J. D. Cockcroft, F.R.S.

DR. J. D. COCKCROFT, whose election to the Jacksonian professorship of natural philosophy, in the University of Cambridge, has just been announced, is, like his predecessor, the present secretary of the Department of Scientific and Industrial Research, both a member of St. John's College and a northerner. Having gained valuable experience in heavy electrical industry at an early stage in his career, Dr. Cockcroft entered St. John's College from the University of Manchester as Dowman Sizar and Hoare Exhibitioner in mathematics in October 1922. In 1924, he obtained the highest possible honours in Part II of the Mathematical Tripos and was elected scholar of his college. Thereafter he was engaged in research in Cambridge, first of a mathematical nature, concerning the heating of transformer coils (1925) and later, at the Cavendish Laboratory, of an experimental character regarding the deposition of surface films by atomic beams (1928). He took his Ph.D. and was elected fellow of St. John's College in 1928. Although his publications have not been numerous since that date, during the last ten years he has contributed in a remarkable degree to the prosecution of physical research in Cambridge. He was largely responsible, with Kapitza, for the design of much of the equipment used in the production of intense magnetic fields in the early years of this period (and latterly the direction of the Royal Society Mond Laboratory has devolved almost entirely upon his shoulders)—and, with Walton, of the arrangement by which nuclear disintegration was first effected by artificially accelerated particles (1932). More recently, he has been the moving spirit in the construction and development of the Cambridge cyclotron, and he has taken over the major work of supervision of the building operations made possible by Lord Austin's bequest. Then, in college, he has filled the office of junior bursar for the last six years, and in the University has been indispensable on numerous executive bodies. He was elected a fellow of the Royal Society in 1936 and this year was the recipient with Walton of the Hughes Medal of the Society. His many friends will wish him well in his new office, and some measure of relief from his numerous extraneous duties.

The Royal Society: New Foreign Members

AT a recent meeting of the Royal Society the following were elected to the foreign membership of the Society: Prof. Walter Bradford Cannon, professor of physiology in Harvard Medical School, Boston, U.S.A., distinguished for (*a*) his X-ray investigations of the movements of the alimentary canal, (*b*) his analysis of the mechanism and conditions of excitation of the suprarenal gland, and (*c*) his work on the chemical transmission of impulses in peripheral nerves as shown by the sympathetic system; Prof. George von Hevesy, research professor in the Institute of Theoretical Physics, Carlsberg Laboratory, Copenhagen, distinguished for (*a*) his work in experimental chemical physics, particularly the use, for the solution of biological and chemical problems, of radioactive and isotopic substances as indicators, (*b*) for his discovery of hafnium, and (*c*) for his geochemical researches and for his work on isotopes and their separation; Prof. Herbert Freundlich, University of Minnesota, Minneapolis, U.S.A., distinguished for his researches in colloid chemistry and colloid physics.

The Linnean Society: New Foreign Members

THE following five biologists were elected foreign members of the Linnean Society of London at the general meeting on May 11: Prof. Alfred Ernst, director of the Institute of General Botany in the University of Zurich, distinguished for his work on apogamy in plants and related subjects, and for his fundamental investigations on heterostyly in Primulaceæ and tropical Rubiaceæ. His monograph on the new flora of the volcanic island of Krakatau was translated into English more than thirty years ago. Dr. William King Gregory, of the American Museum of Natural History, New York, distinguished for his researches on the morphology and evolution of the vertebrate skull and locomotor systems, the evolution of mammalian molar teeth, the phylogeny of fish skulls and the origin of man. Dr. William Marins Docters van Leeuwen, formerly director of the Botanic Gardens, Buitenzorg, distinguished for his work on galls and the various relations between plants and insects, on the regeneration of vegetation on lava and the biology of plants on mountain tops. His recent "Biology of Plants and Animals occurring in the Higher Parts of Mount Pangrango-Gedeh in West Java" and "Krakatau 1883–1933" are outstanding contributions to tropical botany.

DR. ALFRED REHDER, associate professor of dendrology and curator of the Herbarium, Arnold Arboretum, distinguished for his outstanding contributions to the taxonomy of trees and shrubs. His "Manual of Cultivated Trees and Shrubs" is a standard work, as is also "The Cultivated Conifers", which he wrote in collaboration with Prof. L. H. Bailey. His contributions to botanical bibliography include the preparation of the monumental "Bradley Bibliography". He has played a valuable part in suggesting practical additions and emendations to the International Rules of Botanical Nomenclature. Prof. William Albert Setchell, emeritus professor of botany in the University of California, distinguished for his researches on the classification and distribution

of marine algæ, particularly kelps, calcareous algæ and parasitic red algæ. In addition, he is the author of several papers on mosses, fungi and flowering plants. At the same meeting Mr. John Ardagh, clerk in charge of the Library, Department of Botany, British Museum (Natural History), was elected associate of the Society. Mr. Ardagh has an extensive knowledge of botanical literature, and those engaged upon investigations in taxonomy or botanical history greatly appreciate the readiness with which this knowledge is placed at their service.

Dr. E. W. R. Steacie

DR. E. W. R. STEACIE has been appointed director of the Division of Chemistry, National Research Council of Canada, in succession to Dr. G. S. Whitby, who recently resigned to accept the post of director of the Chemical Laboratories of the Department of Scientific and Industrial Research in Great Britain. Dr. Steacie, who will assume his new duties in July, has been a member of the teaching staff of McGill University for the last ten years, being at the present time associate professor of chemistry. During this period most of his time has been spent in the supervision of research by graduate students working on problems in the fields of hydrocarbon chemistry, combustion, chemical kinetics and photochemistry, in which work he is recognized as an authority. Dr. Steacie's studies have been directed largely along lines of fundamental research on problems of industrial importance, such as gaseous combustion, catalysis, pyrolysis of organic compounds, gases in metals, and high-pressure reactions. He has published many scientific papers and treatises, and is an associate editor of the *Journal of Chemical Physics*.

Sir John Eliot, K.C.I.E., F.R.S., 1839–1908

ON May 25, 1839, the distinguished meteorologist Sir John Eliot was born at Lamesley, Durham. Though the son of a schoolmaster, he did not matriculate until he was twenty-six years of age, and he then entered St. John's College, Cambridge. In 1869 he graduated as second wrangler and he was first Smith's Prizeman. After graduating he went to India and successively was professor of mathematics at Roorkee Engineering College (1869–72), at Muir College, Allahabad (1872–74), and professor of physical science at the Presidency College, Calcutta (1874–86). This last post he relinquished to succeed Henry Francis Blanford (1834–93) as meteorological reporter to the Indian Government. He had already served as reporter to the Government of Bengal. In 1899 he became director-general of Indian observatories, retiring from this post in 1903, being made K.C.I.E. He wrote largely on meteorological subjects, and his "Handbook of Cyclonic Storms in the Bay of Bengal" proved of great use to commerce and shipping. Elected a fellow of the Royal Society in 1895, after his return to England in 1904 he was president of the sub-section of astronomy and cosmical physics of the British Association. He died suddenly at his estate at Var, in the south of France, on March 18, 1908.

Civil Defence Research Committee

SIR JOHN ANDERSON, the Lord Privy Seal, has appointed a Civil Defence Research Committee, to be constituted as follows: Dr. E. V. Appleton (chairman), formerly Jacksonian professor of natural philosophy at the University of Cambridge, now Secretary of the Department of Scientific and Industrial Research; Prof. J. F. Baker, professor of Civil engineering at the University of Bristol; Prof. J. D. Bernal, professor of physics at Birkbeck College, University of London; Dr. C. G. Darwin, director of the National Physical Laboratory; Prof. A. J. S. Pippard, professor of civil engineering in the Imperial College, University of London; Prof. R. V. Southwell, professor of engineering science at the University of Oxford; Prof. G. I. Taylor, Yarrow research professor of the Royal Society at Cambridge; Prof. W. N. Thomas, professor of engineering at University College, Cardiff. The secretary of the committee is Dr. E. N. Fox, Cleland House, Page Street, S.W.1. The committee will advise the Lord Privy Seal on programmes of research and experiment. The aim is to secure the fullest possible co-ordination over the wide field of work now comprised in civil defence.

Pottery from Mersin, Cilicia

EXAMPLES illustrative of the whole of the remarkable range of pottery discovered by Prof. John Garstang in his archæological investigations on the prehistoric Cilician site of Mersin in Asia Minor (see NATURE, March 18, p. 464) are to be available for study in Great Britain. Prof. Garstang, in the course of an account of his excavations before the Society of Antiquaries of London on May 11, paid a tribute to the Turkish Government not only for the facilities afforded him for excavation, but also for the generosity with which the authorities had allowed a selection of no fewer than five hundred pieces to be brought to England for exhibition on long-term loan. In making his selection, Prof. Garstang added, his aim had been to secure that the series should be as representative as possible of the whole sequence of development on this very ancient site, and also to demonstrate in the sequence the position of the remarkable early architectural remains, which had been discovered—at present the oldest known. A number of specimens of the pottery were shown by Prof. Garstang to illustrate his lecture, including wares of the Cilician-Hittite periods, as well as of the whole range of the series of the chalcolithic culture, in which several new types are included. Attention was specially directed to the examples of the black ware with white decoration of the late chalcolithic culture of about 3000 B.C., and the trichrome ware from the sixteenth level, showing direct contact with predynastic Mesopotamia and the Tell Halaf culture. Wares from the neolithic level, still incompletely explored, were also shown. Arrangements are being made for the pottery to be allocated to the British Museum and museums at Oxford, Cambridge, Birmingham, Liverpool, Edinburgh, Glasgow and elsewhere. Prof. Garstang also spoke of his discoveries in Cilicia in a Friday evening discourse at the Royal Institution on May 12.

Sir Robert Mond's Bequest to the British Museum

AT the meeting of the Trustees of the British Museum on May 13 the receipt was reported under the terms of the will of the late Sir Robert Mond of the biggest and most important collection of Egyptian antiquities of all periods that has reached the Museum for at least fifty years. The bequest includes 260 objects, which fill gaps in the collections in every class of Egyptian art. Among the sculptures are an Eighteenth Dynasty three-quarter size head and shoulders of an official, a number of *ushabtis*, among which is one contained in a nest of model coffins, also belonging to the Eighteenth Dynasty, and a statuette in steatite, which is especially fine, of an official, Sunuri, of the Nineteenth Dynasty. Of the bronzes, one of the most remarkable, as well as one of the best, is an axe-head of the Eighteenth Dynasty, obviously intended for ceremonial or ornamental use. It is in the Syrian style, and has inserted within its margin an extremely beautiful group of a dog bringing down a wild goat. The bequest also contains jewelry, scarabs, pottery, copies of the Book of the Dead, and some examples of the now well-known Roman portraits from the Fayum. Of these, one represents a woman with a gold tiara and necklace, and is most vivid and convincing. Among other accessions to the Egyptian collections reported is an open-work scarab in gold of the Middle Kingdom (*c.* 2700–2300 B.C.), which is of a type new to the Museum. It has been given by Prof. P. E. Newberry. Two fragments of Anglo-Saxon sculpture, the first to be received for some years, have been presented by Mrs. G. W. Haswell and Mr. F. T. Haswell. Both pieces are in red sandstone, and are North Mercian work of the ninth or tenth century A.D. from Chester or its neighbourhood. The finer fragment is ornamented on both faces and on the sides and end with an interlaced pattern of animals and scrolls, the chief figure being a large lion of barbaric design.

Archæology and A.R.P.

A DISCOVERY of considerable interest to archæologists has been made at Canterbury in the course of excavations for an A.R.P. Control Centre at the rear of the municipal buildings on the Dane John. A Roman pottery kiln has been found in the natural clay at a depth of about seven feet below the present ground level. Associated with the kiln were a number of potsherds, together with some forty to fifty of the tops of jars and other vessels in a variety of shapes and sizes. Among fragments of Belgic and Samian ware is a base which bears the name of the potter, 'Pavlim'. A trench running across the excavation, and extending some four to five feet into the clay, is, it is presumed, the source of the clay from which pots were made. A.R.P. excavation is also responsible for a find, in certain respects of even greater interest, which is reported from Barton-on-Humber, Lincolnshire (*The Times*, May 15). Here human skeletons have been found in association with a number of objects, which are held to be Anglo-Saxon of the fifth or sixth century A.D. They have been examined by Mr. T. Sheppard, of the Hull Municipal Museum. Among the associated antiquities are a large hanging bowl of bronze, with three escutcheons for attachment, probably originally used in the Saxon church of St. Peter, a cylindrical bronze box, with a lid highly decorated, used by Saxon women for needle and thread and having an attachment for suspension to the waist, and a large decorated gold bead. The find of the bronze bowl is of particular interest, as it belongs, presumably, to a class of antiquity which has been made the subject of study by Mr. T. D. Kendrick of the British Museum, and has been shown by him to be of British (Celtic) derivation.

Culture of Pre-Industrial Britain

SIR CYRIL FOX, director of the National Museum of Wales, delivered the annual Im Thurn Memorial Lecture to the Scottish Anthropological and Folk-lore Society on April 17. Sir Cyril emphasized the urgent need of making an adequate record of the cultures of Britain of the pre-Industrial Revolution era, cultures which survive more or less intact in outlying districts, and the material remains of which are still very widely distributed. He had cast his title, "A Field Museum To-morrow: What's to do To-day?", into a colloquial form to emphasize his view that the matter concerned the man-in-the-street in every geographical or political region in Britain. The collection of material for the future national open-air museums should be carried out on rigidly scientific lines, special attention being devoted to things related to life and work on the land. We need the furniture of farmhouse and cottages of every century from the sixteenth; the carts, tools and implements used on the farms: tools used in, and products of, rural industries. Techniques of farm and house building should be recorded and photographed; farm lay-outs should be planned. Only adequately provenanced objects should be collected; only so can we hope to map, ultimately, the cultural regions of pre-industrial Britain. We want to know whether the boundaries of these regions are political or economic. If political, do they go back to the Heptarchy in southern Britain? Outside a few museums, the fate of British folk-material is a sad one—torn from its environment, it is regarded as 'old world' and 'quaint', collected by those from whom its real interest and importance as a manifestation of a once vigorous culture are hidden. How many collectors trouble to record the exact provenance of their specimens?

Exhibit of Historic Aeroplanes

A SPECIAL exhibit of aeroplanes representing an epoch in the history of aviation has been arranged in No. 1 Gallery at the Science Museum, South Kensington, and will be on view for about six weeks. The machines have been lent by Mr. R. G. J. Nash, who has carefully restored them to their original condition and has flown them on various occasions. The exhibit is an interesting supplement to the permanent National Aeronautical Collection which contains such historic machines as the original Wright

biplane of 1903 and the Vickers-Vimy trans-Atlantic aeroplane of 1919. A Blériot monoplane, type XI (Cross-Channel type), was flown by M. Leon Molon at Doncaster in October 1909, where it gained a height record. It has a speed of about 40 m.p.h. and is similar to the machine in which Louis Blériot made his historic crossing of the Channel from the French coast to Dover on July 25, 1909. Another Blériot (type XXVII) with a speed of 80 m.p.h. is the original Gordon Bennett Cup racing machine which Alfred Leblanc flew at Long Island, U.S.A., in 1911. These machines represent the aeroplane in an early stage of its development as a mode of transport—still experimental and confined mainly to exhibition flying and competitions. No degree of standardization had then been reached, and the aeroplane was not regarded as a really proved instrument; the position was still one of uncertainty as to the future of flight. The advent of the Great War in 1914 had, however, a profound effect on the aeroplane, and it produced an intensive development which may be estimated from the example of a Sopwith "Camel" of 1917, a famous fighter scout which was the first aeroplane to be fitted with twin synchronized guns and had a performance undreamt of in 1909, namely, a speed of 113 m.p.h. at 10,000 ft. and a climb to 5,000 ft. in five minutes. An actual wartime Fokker D.VII fighter, which belonged to Jadgstaffel 71 of the German Air Force, also shows the rapid development of the aeroplane for military uses which resulted from the stimulus of war. Another famous aeroplane of the War period is the Vickers-Vimy bomber, which made the first non-stop flight across the Atlantic on June 14–15, 1919, piloted by the late Sir John Alcock with Sir Arthur Whitten Brown as navigator, now exhibited in Gallery VI.

An Early Wet-Plate Folding Camera

VALUABLE additions to the photography collections at the Science Museum, South Kensington, include a complete outfit for the wet-plate process, of date 1854, presented by His Grace the Duke of Devonshire. The outfit comprises a folding wood camera by Ottewill, a sensitizing bath, and a complete set of chemicals and reagents in its original leather carrying case. These objects are all of considerable interest as showing the types of apparatus and accessories necessary for "photography in the field" in the early days of the "photographic art".

Water Pollution

THE forty-sixth Bedson Lecture was delivered by Sir Robert Robertson on May 8 in King's College, Newcastle-upon-Tyne. Sir Robert confined himself to two recent investigations connected with the subject of water pollution. The first of these concerns the pollution problems of the River Tees. A thorough biological and chemical survey of this river has been carried out. This has shown that, whilst the river is unpolluted until its union with the Skerne, the entry of sewage from Darlington in this tributary causes appreciable pollution of the lower reaches. In the estuary, the condition of the river is rendered much worse by industrial refuse containing cyanide. As a result of the investigation, the sewage disposal system of Darlington has been improved, and several undertakings upon Teeside have modified their plants, so that cyanide does not enter the river. With regard to the second topic—the disposal of milk factory waste—Sir Robert said that diluted milk, on account of its easily oxidizable nature, is a potent fish poison. As a result of its consistency, the refuse is difficult to treat by ordinary filtration methods, and success was first obtained by a modified activated sludge process. However, better results have been obtained by use of two filters in series. The refuse is passed first to one filter, *A*, and thence to the second, *B*. When *A* shows signs of clogging, usually in about three weeks, the direction of flow is reversed, that is, the liquid passes first to *B* and then to *A*. Filter *A* then recovers, and in due course the direction of flow is again reversed, and so on.

A Utilitarian Classification of Fragmentary Fossils

IT is generally understood that the generic and specific names given to fossils cannot often be defined so precisely as those given to existing organisms. It is also recognized that the classification of extinct genera into families and orders is not always satisfactory. At the same time, readily distinguishable fossil fragments with definite characters need names, because they can frequently be used to determine the geological age of the rocks in which they occur. Such names are now proving especially useful in the microscopical study of sponge spicules, holothurian and echinoid spicules, plates of star-fishes and crinoids, conodonts, fish teeth and scales, otoliths, pollen grains, and other fragments which denote special conditions or mark horizons in series of rocks. The names are always in the Linnean form, and the so-called genera and species are grouped into so-called families and orders on the Linnean plan. Prof. Carey Croneis, in a recent letter to *Science* (**89**, 314; April 7, 1939), and in an earlier article in the *Journal of Geology* (**46**, 975–984; Oct.–Nov. 1938), points out that this classification is misleading. For the various grades he proposes adopting the terms used in the old Roman army: for species he would use 'centuria'; for genus, 'manipulus'; for family, 'cohors'; and for order, 'legio'. He would thus distinguish a utilitarian classification from one which has the appearance of being natural.

Prevention of Road Accidents

THE report of the Select Committee of the House of Lords, appointed to consider what steps should be taken to reduce the number of casualties on the road, is discussed in *Roads and Road Construction* of May. It is pointed out that since 1910 the number of vehicles on the roads has increased twenty times, and in addition there has been a marked increase of mileage run per vehicle. During the same period the increase in road production is only about two per cent. The Committee is unable to accept the con-

clusions of the Ministry as to the causes to which these accidents are attributed. First, only one cause has been assigned to each accident, although the blame should be distributed in various proportions between road conditions, the road user, the vehicle and both parties involved in the collision. Secondly, the system of police reports on road accidents is often inadequate. Thirdly, the vehicles are sometimes so damaged that it is impossible to say whether they were defective or not. Fourthly, the Committee does not agree with the general principle on which the Ministry proceeds, that even if the condition of the roads and cars was unimpeachable the total of accidents would not be appreciably affected. The Committee believes that segregation of drivers, cyclists and pedestrians on the main roads must come and that the attainment of this ideal is essential if road safety is to be ensured. The highway code should be revised and it should be given the force of law. Witnesses before the Committee were strongly of opinion that an extensive and persistent campaign of educational propaganda should be undertaken and that it should be aimed at every class of road user. The improvement of main roads and the construction of new roads should be carried on simultaneously. 'Lay-byes' and 'draw-ins' should be made on every few miles of highway. The costly system of erecting kerbs should cease and guard posts should be erected 18 inches outside the edges of roads, at suitable intervals, sloping outwards at an angle of 15° from the vertical and provided with reflectors. Many other useful suggestions are made and we hope that some of them will be adopted.

The National Botanic Gardens of South Africa

IN September 1938, the National Botanic Gardens of South Africa, at Kirstenbosch, and the Botanical Society celebrated their silver jubilee, and in the close of the year was produced a special number of the *Journal of the Botanical Society* with some very fine photographs, which show something of the beauty of the Kirstenbosch Botanic Garden with its ideal site on the slopes of Table Mountain. The number contains a brief note by the editor, Prof. R. H. Compton, upon the history of the Gardens, the site of which was selected in 1913 by the late Dr. Pearson, then professor of botany at the South African College. On a motion by Sir Lionel Phillips, the House of Assembly and the Senate passed unanimously in that year a motion that Kirstenbosch, bequeathed to the people of the Cape by Cecil Rhodes as part of his great Groot Schuur Estate, should be granted by the Government as the site of the National Botanic Gardens. The Government consented, making an annual grant towards its support, and at the same time the Botanical Society was formed, with some three hundred subscribers, to enlist public support for the new venture. The early onset of the Great War and the subsequent financial depression has caused delay, but the Director can record many striking indications of progress in the Gardens, and the Botanical Society has now nearly 2,000 members enrolled.

Biology in Education

THE Educational Advisory Board of the British Social Hygiene Council is attempting to give a new orientation to the teaching of biology by bringing it more into touch with individual needs and social problems of to-day. With this aim in view, a Summer School has been arranged at Keble College, Oxford, during July 28–August 4. The School is primarily intended for teachers and others who are concerned with the place of biology in education, but membership will be open to anyone who is interested in the biological problems of modern human life. The inaugural address will be given by Prof. J. Scott Watson. One section of the School will deal with current problems in social biology and their repercussions on the school-child, and another section will be concerned with problems of personal growth and development. These sections will be contributed to by lecturers with considerable experience in their particular fields. The third course will include lectures on subjects of topical interest by prominent workers in biological research, including Mr. C. S. Elton, Dr. S. Zuckerman, Dr. H. N. Sinclair and Dr. Keith Murray. There will be considerable opportunities for discussion, while excursions to places of academic interest are being arranged. Further particulars can be obtained from Mr. T. H. Hawkins, Education Officer, British Social Hygiene Council, Tavistock House South, Tavistock Square, London, W.C.1.

The League of Nations Union

A LEAFLET issued by the League of Nations Union for the assistance of teachers preparing to address their pupils on Empire Day emphasizes the part played by representatives of the British Empire in drafting the Covenant of the League, which is described as a first attempt to apply on a world scale the ideals of democratic government common to the British Commonwealth of Nations and the United States of America. It suggests the possibility of a federation of these and all other democratic States and the sharing of the control of colonial territories and our responsibilities for the development of colonial peoples to full nationhood. The League of Nations Union's arrangements for the summer include: (*a*) for schoolboys and schoolgirls, 'Nansen Pioneer' camps in Devon, Shropshire and Peeblesshire and a summer school at Geneva, and (*b*) for educational administrators and teachers, a conference to be held partly at Geneva, where members will attend the lectures and discussions of the Geneva Institute of International Relations, and partly at a mountain chalet.

The *International Seismological Summary*

THE April, May and June 1933 number of the *International Seismological Summary* has just come into the hands of those recipients who previously stated their wish to have copies straight from the press rather than wait until the annual set could be prepared and bound. This number consists of 148

pages dealing with 180 epicentres, 77 being new and the remainder repetitions from old epicentres. Five deep-focus shocks are listed, namely, those of April 20, May 6, 24, 27 and 28. These were respectively in the Pacific Ocean north-west of the Ladrone Islands, in the Pacific Ocean south of Panama, in the deep ocean off the east coast of Japan, near the Pamirs north-west of India, and in the Pacific Ocean immediately to the south of the main island of Japan. It would be an advantage if all recording stations could send in their readings promptly, so that the interval of six years between the occurrence of earthquakes and the publication of authoritative data on them could be reduced.

Iron and Steel Institute Awards

THE following awards have been made by the Iron and Steel Institute: the Andrew Carnegie Gold Medal for 1938 to Dr. James White, of Glasgow, in respect of his paper on "Equilibrium at High Temperatures in Systems Containing Iron Oxides"; an Andrew Carnegie Gold Medal also to Dr. W. Ruff, of Wetzlar-Lahn, Germany, in respect of his paper on "The Running Quality of Liquid Malleable Iron and Steel", published in 1936; the Williams Prize for 1938 for a paper of practical interest to Mr. D. V. Krishna Rao of Bhadravati, India, in respect of his paper on "The New Steel Plant of the Mysore Iron and Steel Works, Bhadravati, India"; the Ablett Prize for 1939, for a paper by a junior engineer, to Mr. H. Escher of Wollongong, Australia, for his paper on "Ten Years' Development in Steam Engineering at the Port Kembla Steel Works, N.S.W., Australia". The following Andrew Carnegie research scholarships have been awarded: O. Gessner (Breslau, Germany), £100 in aid of a research on the viscosity of cast-iron alloys, steel, metals and alloys and slags; B. Ljunggren (Stockholm, Sweden), £100 for a microsclerometric investigation of grain boundaries; G. Parker (University, Leeds), £100 in aid of a research on oxidation and scaling of steel.

Institution of Electrical Engineers Awards

THE Council of the Institution of Electrical Engineers has made the following award of premiums for papers read or published during the session 1938–39: *Institution Premium*, to Dr. T. E. Allibone, F. E. Bancroft and G. S. Innes; *Ayrton Premium*, to F. W. Lawton; *Fahie Premium*, to K. L. Wood; *John Hopkinson Premium*, to N. F. T. Saunders; *Kelvin Premium*, to Dr. L. Hartshorn and E. Rushton; *Paris Exhibition* (1881) *Premium*, to R. Nelson; *Webber Premium*, to N. F. S. Hecht; *Overseas Premium*, to H. S. Hvistendahl; *Extra Premiums*, to G. H. Fletcher and A. Tustin; Dr. W. Betteridge and J. A. Laird; F. Brailsford; J. Higham and J. P. Wolfenden; Dr. K. L. Jensen; *Wireless Section Premiums*, to L. W. Hayes and B. N. MacLarty (Duddell Premium); Dr. J. D. McGee and Dr. H. G. Lubszynski; Dr. R. L. Smith-Rose and Dr. H. G. Hopkins; P. R. Coursey and S. N. Ray; *Meter and Instrument Section Premiums*, to Dr. E. G. James, G. R. Polgreen and G. W. Warren (Silvanus Thompson Premium); Dr. H. M. Barlow; D. C. Gall; G. F. Shotter; *Transmission Section Premiums*, to Dr. W. G. Radley and C. E. Richards (Sebastian de Ferranti Premium); Prof. W. J. John and Dr. C. H. W. Clark; E. W. W. Double and W. D. Tuck; T. R. Scott and R. C. Mildner.

Announcements

MR. F. J. DU TOIT, representative of the Union of South Africa on the executive council of the Imperial Agricultural Bureaux, has been appointed chairman of the council, in succession to Lieutenant-Colonel George P. Vanier, who resigned on taking up an official appointment abroad.

A COMMITTEE has been formed to present Prof. Jules Bordet, director of the Brussels Pasteur Institute, with a medal on the occasion of his being made a Commander of the Legion of Honour. Subscriptions should be sent to M. Georges Masson, 120 Boulevard Saint Germain, Paris 6e.

AT the annual general meeting of the Institute of Wireless Technology held on April 28, the following officers were elected for the year 1939–1940: *President*, Mr. Sydney A. Hurren; *Honorary Treasurer*, Mr. George Lea. The assistant secretary is Mr. E. Carter, I.W.T., 4 Vernon Place, Southampton Row, London, W.C.1.

PROF. FREDERICK C. LEONARD, chairman of the Department of Astronomy of the University of California, Los Angeles, will be visiting professor of astronomy in the summer session of the University of British Columbia, Vancouver, Canada, during July 3–August 18, while Prof. Daniel Buchanan, dean of the Faculty of Arts and Science and head of the Department of Mathematics of the University of British Columbia, will be visiting professor of astronomy and mathematics in the summer session of the University of California, Los Angeles, during June 26–August 4.

THE twenty-sixth annual meeting of the Swiss Röntgen Society will be held in Zurich on June 3 and 4, when the subjects for discussion will be cosmic radiation, the biology of cosmic radiation and the radiological appearance of pulmonary tumours. Further information can be obtained from the secretary, Dr. Max Hopf, Effingerstrasse 49, Bern.

VOLUME 35*A* of the *American Journal of Science* (1938) is dedicated to Dr. Arthur L. Day and contains a series of papers by members of the scientific staff of the Geophysical Laboratory of the Carnegie Institution of Washington, from the directorship of which Dr. Day retired in 1936. In a short foreword it is stated that the publications from the Laboratory number one thousand and contain a body of knowledge which is being successfully employed in the interpretation of geological observations. The volume contains several very interesting papers, among which may be mentioned those on the system water – boron oxide and the system calcium sulphate – water, which elucidate some previously obscure points in these subjects.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 860.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Emission of Neutrons accompanying the Fission of Uranium Nuclei

THE experiments of Halban, Joliot, and Kowarski described in NATURE[1] give an indirect proof of the neutron multiplication accompanying the fission of uranium nuclei after neutron capture. It can be deduced from these experiments that the additional neutrons are, on the average, faster than the photo-neutrons from radium C - beryllium used as active primary radiation. This conclusion is confirmed in a subsequent note[2] by the same authors in which they find that the neutrons contributed by uranium are able to produce the endo-energetic reaction $S(n,p)P$.

I have made some experiments on the same problem by a different method. Any increase of neutron effects observed when neutrons are allowed to pass through a given medium may be due: (*a*) to the inelastic scattering of neutrons, (*b*) to the reaction $(n,2n)$ or, exceptionally $(n,3n)$; (*c*) to an unknown cause, as in the case of uranium to the fission of its nuclei. In the experiments of Halban, Joliot and Kowarski, effects (*a*) and (*b*) are excluded owing to the integrating method adopted and to the low energy of the primary neutrons. But if these effects are present, it is possible to estimate their importance relatively to effect (*c*) by comparing uranium with substances in which only effect (*a*) or only (*a*) and (*b*) are possible. I have used aluminium and copper as comparison substances of the first and of the second type respectively.

A radon plus beryllium source was placed in the cylindrical axial hole of a cylinder of aluminium, of 2·2 cm. diameter and 5 cm. height, or, alternatively, of a cylindrical double-walled vessel of identical dimensions filled with uranium oxide (U_3O_8) or copper oxide. The mass of aluminium was 40 gm., of uranium oxide 49 gm. and of copper oxide 42 gm., and the thickness of walls could be neglected. The number of absorbing or scattering uranium nuclei was therefore 9·2 times smaller than the corresponding number of aluminium nuclei and 3·3 times smaller than the number of copper nuclei. One would expect, therefore, that the effect (*a*) due to aluminium, and effects (*a*) and (*b*) due to copper would be at least of the same importance and probably larger than the same effects due to uranium. The number and quality of neutrons issuing from these substances were compared by measuring the activation of a silver foil surrounding the cylinders in two cases: first, when no appreciable scattering of neutrons took place outside the cylinders, and secondly, when the neutrons were scattered back by a cylindrical sheet of paraffin wax of 6 mm. thickness. The results are given below, the figures being the total numbers of counts of a Geiger-Müller counter in corresponding series.

It can be inferred from these data that uranium gives off, in fact, more neutrons than aluminium or copper. The increase is larger relatively to aluminium than to copper, which must be attributed to the reaction $(n,2n)$ occurring in this last element. In both cases, the increase is larger when the neutrons are slowed down by a small quantity of paraffin, which shows that the additional neutrons from uranium are, on the average, slower than the bulk of primary neutrons emitted by the source. As, from other evidence, they appear to be faster than the radium C - beryllium neutrons, we can estimate that their *average* energy must be of the order of 1 Mev.

	Aluminium	Uranium	Increase (%)	Copper	Uranium	Increase (%)
No paraffin	9,089	9,325	2·6	4,810	4,869	1·2
With paraffin	10,285	10,775	4·8	10,049	10,292	2·4

Owing to the small number of uranium nuclei acting as absorbers or scatterers, it seems very unlikely that the apparent excess of neutrons given off by these nuclei should be due to some trivial cause like the inelastic scattering or the reaction $(n,2n)$. It probably represents the 'neutron shower' accompanying the fission of an activated uranium nucleus. Assuming the cross-section for this process produced by the neutrons from radon plus beryllium equal to 5×10^{-25} cm.^{2}, I calculate that the number of neutrons emitted in a single fission is equal to 6.

J. ROTBLAT.

Mirosław Kernbaum Radiological Laboratory of the Scientific Society of Warsaw, Warsaw. April 8.

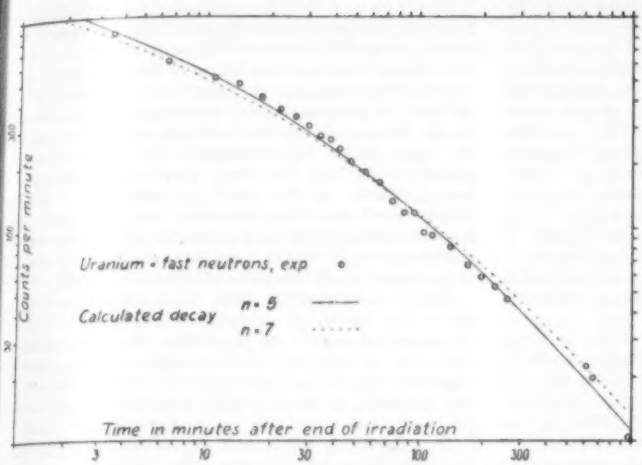
[1] NATURE, **143**, 470 (1939).
[2] *C.R.*, **208**, 995 (1939).

Statistical Calculation of Composite Decay Curves

WHEN uranium or thorium is bombarded with neutrons, a number of radioactive bodies are formed with periods ranging from a few seconds to several days. The decay of this assembly of fission products (not chemically separated) has been studied by Bjerge, Brostrøm and Koch[1] and found to be practically the same for thorium and uranium. They have pointed out that this may be due partly to the fact[2] that some of the fission products are the same for uranium and thorium but that, apart from this, the large number of periods would tend to wipe out any individual features of the decay curve.

This suggests that it would be possible to calculate the decay curve of such an assembly by the use of statistical assumptions on the distribution of periods. I have made such a calculation, based on admittedly crude assumptions, the result of which is indicated by the full line in the accompanying diagram, while the circles represent the measured decay[1].

In this calculation, the actual (discontinuous) assembly of periods is replaced by a continuous distribution with a suitable density function $f(\lambda)d(\lambda)$, where λ is the decay constant. We introduce the decay energy E, using Sargent's law $\lambda = k.E^n$, and assume the density function with respect to E to be constant. (This may be justified by arguing that the decay energy of a radioactive isotope is roughly proportional to the



difference, in nuclear charges, from the stable isobar and that, after infinitely long irradiation, all values, within relevant limits, for this difference will be about equally represented among the nuclei resulting from the fission and subsequent β-decay.) The decay curve is then obtained by integrating:

$$J_\infty(t) = \int_0^\infty f(\lambda) e^{-\lambda t} d\lambda = \int_0^\infty \text{const.}\, e^{-k.E^n} dE = \text{const.}\, t^{-1/n},$$

where $J_\infty(t)$ is the number of atoms decaying per unit of time, at the time t after the end of an infinitely long irradiation. If the irradiation has the finite duration T, we get

$$J_T(t) = \text{const.}\, (t^{-1/n} - (t + T)^{-1/n}).$$

This function, for $T = 100$ minutes and $n = 5$, is represented by the full line in the diagram. The close agreement with the experimental points would seem to support the choice of $n = 5$, but actually $n = 7$ (the dotted line) fits almost as well. The small differences are probably real and due to the individual periods. The smallness of these deviations emphasizes to what high degree the influence of the single periods is smoothed out, and indicates that the similarity between the thorium and uranium decay curves can be explained entirely on this basis, without assuming any similarity in the details of the distribution of periods.

O. R. FRISCH.

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May 4.

[1] Bjerge, Brostrom and Koch, NATURE [143, 794 (1939)].
[2] Hahn and Strassmann, *Naturwiss.*, **27**, 89 (1939). Aten, Bakker and Heyn, NATURE, **143**, 679 (1939).

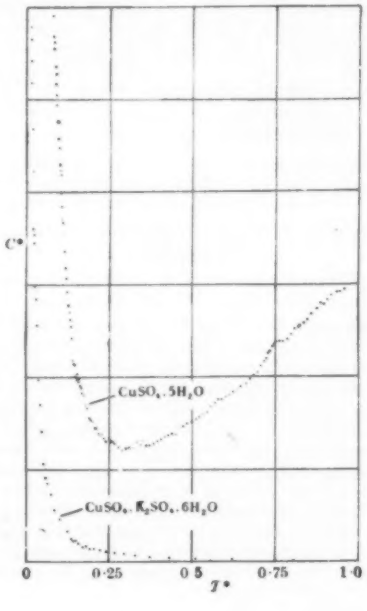
Specific Heat of Copper Sulphate below 1° K.

IT is well known that cæsium titanium alum exhibits no specific heat anomaly due to Stark splitting, but only a large increase at very low temperatures attributed to magnetic interaction between the ions. This is explained by the well-supported hypothesis that the orbital momentum is quenched, leaving the ion effectively in an ^2S state since it possesses only one electron spin, and Kramers has shown that the ^2S state is remarkably free from splitting due to the lattice field. The cupric ion would be expected to behave similarly, since susceptibility measurements show that the orbital momentum is largely quenched and since there is only one electron spin.

Experiments have therefore been carried out on the specific heats of copper sulphate and copper potassium sulphate below 1° K. Only relative measurements were attempted, so that the ordinates in the two graphs below are arbitrary. A constant influx of heat was maintained by an external γ-ray source, and the susceptibility was measured very precisely with an inductance bridge as the salt warmed up. The temperatures T^* in the curve below were derived on the assumption that the Curie law holds below 1° K., but it seems unlikely that this is very much wrong in the upper part of the range since the law holds approximately at helium temperatures. No correction has been applied for the demagnetizing coefficient.

The specific heat of copper potassium sulphate is entirely in accord with expectation as it exhibits only a sharp rise due to magnetic interaction at a very low temperature (0·01° T^*). It was accordingly possible to reach 0·005° T^* by demagnetizing from 35·9 kilogauss and 1·17° K. The salt thus compares favourably with cæsium titanium alum as a means of reaching extremely low temperatures, and has the advantage of being cheap and easily obtained.

It would be expected that copper sulphate would behave in much the same way as the double salt since the ionic moment is the same when calculated from the low field susceptibility of either compound



in the helium range[1], so that the quenching of the orbital momentum should apply equally in the two cases. Owing to the closer approach of the ions, the magnetic interaction specific heat is naturally shifted to a higher temperature, but the most remarkable feature is the presence of a very large specific heat throughout the whole region below 1° K. A first survey of the specific heat in the helium range indicated that it only falls to a low value at about 4·5° K. The large extent of the maximum is remarkable and may have important applications in experimental technique. The specimen was an ellipsoid of axis ratio 3·18 : 1, and consisted of very many small crystals of purity better than 99·9 per cent compressed by about 100 atmospheres into a coherent mass.

An attempt was made to estimate absolute temperatures by demagnetizing from different fields at the same bath temperature, and calculating the entropy of magnetization assuming the Brillouin formula and taking $j = \frac{1}{2}$. The calculation broke down for demagnetization from those fields which were so low that the level splitting was comparable with the energy of magnetization, but we may accept with caution the values for the lower temperatures produced by demagnetization from the higher fields. It appears probable that the susceptibility becomes extremely large at 0·05° K., so that we might expect ferromagnetism near this temperature. The lowest point reached with copper sulphate was 0·08° K. (0·03° T^*), but no hysteresis was observed with a ballistic galvanometer, though the arrangement was amply sensitive to detect the effect in ferric alum.

While it would be rash at this stage to attempt a detailed explanation, the general conclusion must be drawn that in copper sulphate there does exist a splitting of the energy levels such as to give a high specific heat in the helium range. Unless the effect is due to exchange forces, which seems improbable in view of the high dilution, it must be assumed that the electric field of the lattice can, in certain circumstances present in copper sulphate but absent in copper potassium sulphate, produce a level splitting even in an ion which is effectively in an ^2S state owing to the quenching of its orbital momentum.

J. ASHMEAD.

Royal Society Mond Laboratory,
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March 29.

[1] Reekie, J., in the Press.

Sparking Potential of Deuterium (Heavy Hydrogen)

THE sparking potential of heavy hydrogen between parallel electrodes was recently measured in this laboratory, and the influence of the material of the cathode was also examined. In accordance with the general theory of the discharge, the effect of a change of cathode material was most pronounced at the minimum sparking potential, which was found to be characteristic of the metal of the cathode after it had been de-gassed. Further, for any given metal the minimum sparking potential was found to be very sensitive to the state of the cathode surface even after it had been de-gassed in a vacuum furnace, as exposure of the cathode to the gas for any length of time had a marked effect in lowering the sparking potential.

The value of the minimum sparking potential of heavy hydrogen characteristic of a steel cathode was found to be 339 volts, as the experiments indicated that lower values, obtained after the metal had been exposed to the gas at pressures exceeding about 20 mm. of mercury, were probably due to adsorbed layers of the gas on the cathode surface. However, in many cases, bombardment of the cathode by positive ions in a discharge was able to restore the higher values of the sparking potential. Similar effects were also observed with light hydrogen, and the minimum sparking potential with a steel cathode was found to be more than 10 per cent greater than that recently given for a platinum cathode[1].

Hence the results show that typical diatomic gases like hydrogen and deuterium behave like the monatomic gases[2,3] in that the minimum sparking potential is strongly characteristic of the cathode material, and increases with the work function of the cathode, a result which was not supported by the early measurements with the diatomic gases.

In comparing the two isotopes, it was found that for six different cathodes the minimum sparking potential of deuterium was greater than that of hydrogen by about 3 per cent, but that when the spark parameter pd was about 5 (mm. of mercury × cm.) the sparking potential V of the two gases was the same. The normal cathode fall is also known to be greater in deuterium than in hydrogen[4]. Now, it is reasonable to assume that the coefficient of ionization of deuterium by electrons is not very different from that of hydrogen, especially at high values of the ratio of V/pd, a view supported by the measured values of the force in the positive column[5]. On this assumption, then, the difference between the sparking potentials of the two gases can be accounted for if, at the same value of V/pd, the deuterium positive ion is 20 per cent less effective than the hydrogen ion in liberating electrons from the cathode, although both ions have the same potential energy. The difference must therefore be due to the lower velocity of the deuterium ion. Further, if this constitutes the main difference between the electrical properties of the two gases, it also accounts for the equality in the sparking potentials when pd is about 5.

F. LLEWELLYN JONES.

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April 14.

[1] Ehrenkranz, *Phys. Rev.*, **55**, 219 (1939).
[2] Llewellyn Jones and Galloway, NATURE, **138**, 973 (1936). *Proc. Phys. Soc.*, **50**, 207 (1938).
[3] Llewellyn Jones and Henderson, *Phil. Mag.*, in the Press.
[4] Guntherschulze und Schnitger, *Z. Phys.*, **103**, 491 (1936).
[5] Steenbeck, *Z. tech. Phys.*, **11**, 397 (1936).

Penetration of the Potential Barrier and Formation of AlH

SEVERAL investigators have observed peculiar anomalous intensities in the band system $^1\Pi - {}^1\Sigma$ of the spectrum from AlH. Generally the lines from rotational levels $J > 17$ in $v = 0$ and $J > 7$ in $v = 1$ $^1\Pi$ are weakened or absent according to the circumstances in the light-source.

In order to investigate whether formation of AlH takes place in the $^1\Pi$-state, I have repeated an experiment of Wurm[1], who investigated the spectrum of aluminium in a hydrogen atmosphere in an electric furnace. My spectrograms show that all

lines from upper levels with $J > 19$ in $v = 0$ and $J > 7$ in $v = 1$ have appreciably greater intensities than lines from levels with lower J-values. These enhanced lines are those absent at low pressure in the spectrum of the arc, that is, lines emitted from the predissociating levels above the limit of dissociation in $^1\Pi$. In the furnace, however, at all pressures investigated (1-400 mm.) the AlH-spectrum has the appearance mentioned above, if *the exposures are taken immediately after the furnace was fitted with fresh aluminium and hydrogen*. The great intensities of the enhanced lines show that a considerable new formation of AlH-molecules takes place in these states. This is a direct proof and demonstration of molecular formation by the hydrogen atom penetrating the potential barrier.

During the investigation of this problem, the following observations were made:

(1) When the temperature is increased in the tube, the intensity is shifted toward larger J-values of the enhanced lines.

(2) The (1,1) band is more intense than the (0,0) band and the (1,2) band more intense than the (0,1) band. These intensity relations are the opposite to those in the spectrum of the AlH arc.

(3) In the (0,0) band the enhanced lines of the P-branch have almost the same intensities as the corresponding lines of the Q-branch and considerably greater intensities than the corresponding R-branch lines.

(4) The effects mentioned in (3) are not appreciable in other bands of $^1\Pi - {}^1\Sigma$ investigated.

(5) If several exposures are taken successively without changing the conditions of the light-source, the spectrograms show that the intensities of the bands, especially the intensities of the enhanced lines, decrease, so that the enhancing effect is gradually diminished.

(6) The effects of (5) develop faster at low than at higher pressures.

(7) The intensity ratio between the enhanced and the remaining lines is greater in the (0,0) band than in the other bands.

(8) In the (0,0) band, Q_{1s} and P_s are superposed, and this line has on all my plates anomalous low intensity.

Further work in this line, which is in progress, will be published later in detail in connexion with discussions regarding the origin of these very distinct effects. Further, I shall try to apply the results obtained to explain the anomalous intensities in the spectrum of HgH and the pressure effects in AlH.

G. STENVINKEL.

Department of Physics,
University,
Stockholm.
Feb. 19.

[1] Wurm, K., *Z. Phys.*, **78**, 309 (1932).

Stress Tensor and Particle Density in Special Relativity Theory

THE stress-momentum-energy tensor of a relativistically perfect fluid in the absence of exterior forces is

$$T_{ij} = -(\rho + p)i_i i_j + p g_{ij}, \qquad (1)$$

where $h, i, j \ldots = 1, 2, 3, 4$, g_{ij} is the fundamental tensor of space-time (signature $- - - +$), $i^h = \frac{dx^h}{ds}$ is the Minkowskian velocity of the macroscopical motion ($i^h i_h = 1$), p the pressure and ρ the proper energy-density. Elsewhere[1] I have shown that a fluid is only perfect in the relativistic sense if it is 'perfectly perfect', that is, if not only viscosity but also heat conduction is negligible. So long as (1) holds, no transition of heat between adjacent parts of the fluid occurs and the motion takes place without increase of entropy.

The question has been raised by Eddington[2] whether ρ/mc^2 can be identified with the proper *particle* density if the fluid is chemically homogeneous, m being the mass of one molecule. Eddington's answer is in the negative; according to him, the particle-density is ρ_0/mc^2 where $\rho_0 = -T^i_i = \rho - 3p$. Recently Synge[3] has shown Eddington's result to be incorrect and re-established ρ/mc^2 as the particle density.

It can be shown, however, that the proper particle density is neither ρ/mc^2 nor ρ_0/mc^2 but a third quantity, say, $\tilde{\rho}/mc^2$, independent of both and not even derivable from T_{ij} at all. But for an ideal gas of not excessively high temperature, $\tilde{\rho}$ is *approximately the mean value of* ρ *and* ρ_0. Hence, though Eddington's value ρ_0 for the proper particle density was wrong, his criticism against Schwarzschild's value ρ was right. The general discussion will be given elsewhere; here the following elementary argument may suffice. Though the result is valid in general relativity also, it has been formulated here for special relativity theory only. For simplicity, factors $\sqrt{-g}$ have been dropped.

The argument depends upon the fact that the molecules have motions different from the macroscopical motion. Let ν be the *proper* particle density of molecules moving with a definite Minkowskian velocity $e^h = \frac{dx^h}{ds}$ ($e^h e_h = 1$), so that ν is a function of e^h and that νdV is the number of molecules contained in a 3-dimensional element dV orthogonal to *their* world-lines, that is, to e^h. Elements like dV are supposed to contain still a large number of molecules. Then the number of molecules contained in an *arbitrary* 3-dimensional element of magnitude dV and normal to the unit-vector n^h is $\nu e^h dV_h$, where $dV_h = n_h dV$. Hence the total momentum and (negative) energy of these molecules is $-mc^2 \nu e_i e^h dV_h$. After summation with respect to all directions e^h this must become $T_i{}^h dV_h$, hence

$$T_{ij} = \Sigma - mc^2 \nu e_i e_j. \qquad (2)$$

In particular, $\rho_0 = -T_i{}^i = \Sigma mc^2 \nu$. Moreover, choosing orthogonal co-ordinates at rest with respect to the macroscopical motion (so that $i^1 = i^2 = i^3 = 0$, $i^4 = 1$), $e_4 = 1/\sqrt{1 - v^2/c^2}$, where v is the ordinary velocity belonging to e^h. Hence

$$\rho = -T_{44} = \Sigma mc^2 \nu (e_4)^2 = \Sigma mc^2 \nu/(1 - v^2/c^2) \sim \rho_0 + \rho_1 + \rho_2, \qquad (3)$$

where $\rho_1 = \Sigma m v^2 \nu$, $\rho_2 = \Sigma m v^4/c^2 \nu$, and powers of v^2/c^2 higher than the second have been neglected.

The number of molecules $\tilde{\rho} dV/mc^2$, however, contained in an element dV orthogonal to the *macroscopical* world-lines, that is, to i^h is $\Sigma \nu e^h i_h dV = \Sigma \nu e_4 dV$; hence

$$\tilde{\rho} = \Sigma mc^2 \nu e_4 = \Sigma \frac{mc^2 \nu}{\sqrt{1 - v^2/c^2}} \sim \rho_0 + \tfrac{1}{2}\rho_1 + \tfrac{3}{8}\rho_2. \qquad (4)$$

The equation of state for an ideal gas (which is valid in relativity theory also[4]) leads to the relation $p = kT\tilde{\rho}/mc^2 = \tilde{\rho}\tau$, where kT is the proper temperature measured in energy units, so that $\tau = kT/mc^2$

is a very small number (of the order of about $10^{-12}T$); ρ_1 is of the order of τ and ρ_2 of the order of τ^2. As, moreover, $p = \frac{1}{3}(\rho - \rho_0)$, we have:

$$\rho = \tilde{\rho} + \tfrac{3}{2}p + \tfrac{1}{2}\rho_2 = \tilde{\rho}(1 + \tfrac{3}{2}\tau) + \tfrac{1}{2}\rho_2, \quad (5)$$

$$\rho_0 = \tilde{\rho} - \tfrac{3}{2}p + \tfrac{1}{2}\rho_2 = \tilde{\rho}(1 - \tfrac{3}{2}\tau) + \tfrac{1}{2}\rho_2. \quad (6)$$

In the second member of (5), the first term corresponds to the sum of the proper energies of the molecules (which is smaller than the proper energy of the element of matter they constitute), the second term to the classical kinetic energy of the relative translatory motion, and the third term to the relativistic correction. If the latter is neglected (which means neglect of v^4/c^4 in (3), (4)), we obtain from (5), (6):

$$\tilde{\rho} \sim \tfrac{1}{2}(\rho + \rho_0). \quad (7)$$

Finally, it may be remarked that in the case where p is a function of $\tilde{\rho}$ alone, so that the hydrodynamical integral $P = \int dp/\tilde{\rho}$ exists, $mc^2(1 + P)$ is the average value per molecule of the so-called proper *enthalpy* or heat-content $E + pV$, so that[5]

$$T_{ij} = -\tilde{\rho}(1 + P)i_i i_j + pg_{ij}. \quad (8)$$

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Technische Hoogeschool,
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March 22.

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[4] Jüttner, F., *Ann. Phys.*, (4), **34**, 856–882 (1911); (4), **35**, 145–161 (1911). *Z. Phys.*, **47**, 542–566 (1928). Tolman, R. C., *Phil. Mag.* **39**, 583–600 (1914).
[5] Cf. Pauli, W., *Enz. Math. Wiss.*, **2**, 692 (1920), where the older literature is mentioned.

Motion of the Spiral Nebulæ

THE shift of the spectrum lines of the spiral nebulæ towards the red is commonly accepted as evidence of a high velocity in the line of sight away from the solar system.

I venture to suggest that the shift may not be a Doppler effect at all; but the well-known genuine slowing down of atomic vibrations predicted by the Lorentz-Larmor electromagnetic theory, which has recently been conclusively demonstrated in laboratory experiments in the case of hydrogen canal rays by Ives and Stilwell[1].

On this interpretation, all the extra-galactic nebulæ must be regarded as rotating about the galaxy as centre, so that we have a velocity of revolution instead of a radially outward one; but its magnitude is even more staggering than the required radial velocity. If $\Delta\lambda$ is the increase in the wave-length, λ, the required radial velocity u is given by $\Delta\lambda/\lambda = u/c$, where c is the velocity of light; but the required transverse velocity v is given by $\Delta\lambda/\lambda = (1-v^2/c^2)^{-\frac{1}{2}} - 1$; or by $\Delta\lambda/\lambda = v^2/2c^2$ if v^4/c^4 is negligible. In this case the relation between v and u for the same shift is $v^2 = 2cu$.

Thus, taking the typical nebulæ velocities at distances of 10^7 and 10^8 light-years as 1,700 and 17,000 km./sec. respectively, the required transverse velocities work out as 32,000 and 100,000 km./sec. respectively. So nebulæ at these two distances would take 580 and 1,850 million years respectively to perform one revolution; this gives proper motions too small to have been detected so far.

Since the radial velocity u has been found to be proportional to the distance r, we shall have v^2/r as constant. Thus all the nebulæ possess approximately the same radial acceleration. If the nebulæ occupy a spherical volume, with rough symmetry, this means that the total mass inside a sphere of radius r is proportional to r^2. But the radial acceleration requires a much greater amount of mass than appears actually to be present. I find that the number of nebulæ, each of mass 3,500 million suns, which would be required inside spheres of 10^7 and 10^8 light-years, works out at 2×10^8 and 2×10^{10} respectively. This latter seems about 10,000 times too great. The acceleration might be accounted for by the supposition of cosmic dust between the nebulæ, of densities $2{\cdot}7 \times 10^{-31}$ and $2{\cdot}7 \times 10^{-33}$ gm./c.c. at 10^7 and 10^8 light-years, respectively, which shared in the general rotation of the system of nebulæ. This would give a mass of about 12 grams of material per sq. cm. of cross-section, lying between distances of 10^6 and 10^8 light-years, which, although it is only about 1 per cent of the earth's atmosphere, will be difficult to reconcile with no more absorption than actually exists, unless the material exists as separate atoms or molecules instead of as dust particles.

This possible rotation of the whole system of spiral nebulæ makes the estimated rotation of the galaxy require further investigation.

I put forward this suggestion on the motion of the spiral nebulæ to see if it can be found tenable in the face of criticism. I know it has its difficulties, especially as, so far as I know, no evidence of symmetrical distribution with respect to any axis has been discovered among the spiral nebulæ; but it avoids some of the difficulties associated with the idea of radial velocities.

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The University,
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April 1.

[1] *J. Opt. Soc. Amer.*, **28**, 215–226 (1938).

Influence of Micelle Formation on Flotation

IT has been noted[1] that cetyl-trimethyl-ammonium bromide is a collector for (that is, induces floatability of) several different types of mineral. The minimum effective concentration of the compound (threshold concentration) required to induce flotation differs from mineral to mineral, but when the concentration has been increased to a value lying between 100 mgm. and 500 mgm. a litre, flotation ceases to be possible for all minerals. This is about the concentration (280 mgm. a litre) at which micelle formation of the ammonium salt becomes considerable[2].

We have recently found that flotation ceases to be possible in solutions of certain other paraffin chain compounds, for example, sodium cetyl sulphate and potassium laurate, at the concentration at which micelle formation occurs. Moreover, neutral salts, such as sodium and calcium chlorides, which diminish the concentrations necessary for micelle formation, also diminish the concentrations necessary to prevent flotation. It is concluded that there is a direct correlation between micelle formation and prevention of flotation.

Flotation is dependent upon orientated adsorption of the collector at the mineral surface, which enables contact with the air bubble to occur, but contact is hindered[1] when the air bubble is 'armoured' by adsorbed paraffin chain molecules and micelles. This

is proved by the fact that, in solutions just below the strength required for micelle formation, contact between mineral and a newly formed bubble may be possible when contact with an aged bubble is impossible.

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I. W. WARK.

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Feb. 20.

[1] Wark, I. W., *J. Phys. Chem.*, **40**, 661 (1936).
[2] Adam, N. K., and Shute, H. L., *Trans. Farad. Soc.*, **34**, 759 (1938).

Structure of Alginic Acid

ALGINIC acid, the industrial importance of which is increasing, constitutes a large proportion of the dry weight of certain seaweeds. It is noteworthy among polysaccharides in that it appears to be built up entirely of *d*-mannuronic acid residues, although its resistance to hydrolysis is so great that no quantitative transformation to *d*-mannuronic acid has been achieved[1]. The results we have recently obtained from a study of the action of methyl alcoholic hydrogen chloride on the polysaccharide show that high yields of *d*-mannuronic acid are obtainable from alginic acid.

Furthermore, we succeeded in isolating, by the use of the same reagent, a partially degraded form of alginic acid of comparatively low molecular weight. Except for the lower viscosity of its solutions, this material differed little from the original alginic acid, but it was more amenable to chemical transformation. From it, by use of thallium ethoxide and methyl iodide, we obtained the corresponding fully methylated derivative. This methyl derivative was exceptionally stable towards hydrolytic agents, but two methods were developed which gave insight into its chemical structure. When boiled with strong nitric acid it underwent hydrolysis, followed by degradative oxidation, with formation of *meso*-dimethoxy succinic acid (v). This indicated that in each of the mannuronic acid residues the methyl groups were attached at C_2 and C_3.

Conclusive proof of this was provided as follows. Methylated alginic acid on drastic treatment under pressure with methyl alcoholic hydrogen chloride gave the methyl ester of 2 : 3-dimethylmannuronide (II). The latter, after hydrolysis followed by oxidation (bromine water), yielded 2 : 3-dimethyl mannosaccharic acid (III), and this in turn was oxidized by periodic acid (reagent for oxidative degradation of α β glycols[2]). The products were glyoxylic acid (IV), and the half aldehyde of *meso*-dimethoxy succinic acid from which the crystalline methyl *meso*-dimethoxy succinate (V) was then obtained quantitatively. It follows that in the methylated alginic acid the methyl groups were situated at C_2 and C_3 respectively, and it appears that alginic acid is composed of *d*-mannuronic anhydride residues linked glycosidically. In addition, it is clear that in alginic acid there occurs a chain of *d*-mannuronic acid residues in each of which the hydroxyl groups at C_2 and C_3 are free. The glycosidic linkage must therefore be either 1 : 4 (pyranose ring structure) or 1 : 5 (furanose ring structure).

In view of the extreme stability of alginic acid and its large negative rotation, it is highly probable that the ring structure is pyranose and that the linkage between the residues is 1 : 4. We conclude therefore that at least the major portion of the alginic acid molecule is composed of β-*d*-mannuronic acid residues linked as shown in (I). At present, owing to the experimental difficulties connected with the hydrolysis of such intractable material, it is not possible to say whether the whole of the alginic acid molecule is so constituted, and further work on this subject is in progress.

The structural resemblance between (I) and the formula for cellulose (chains of β-*d*-glucopyranose units with 1 : 4 linkage) is apparent, and a further point of interest is that in pectic acid[3], as shown recently in this laboratory and by Dr. F. Smith of the University of Birmingham, a similar structure is encountered, the residues in this case being α-*d*-galacturonic acid (pyranose form) linked glycosidically through positions 1 and 4.

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April 5.

[1] Nelson and Cretcher, *J. Amer. Chem. Soc.*, **51**, 1914 (1929); **54**, 3409 (1932). Bird and Haas, *Biochem. J.*, **25**, 403 (1931). Schoeffel and Link, *J. Biol. Chem.*, **100**, 397 (1933).
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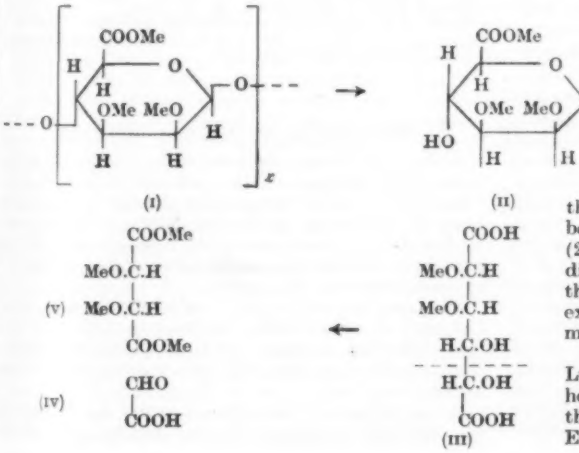
[3] *Chemistry and Industry*, **58**, 363 (1939).



Further Experiments on Homing in Storks

As previously stated[1], white storks have a prominent instinct of direction. In order to obtain further information on this problem we carried out the following experiments in 1938: (1) to ascertain the maximal distance from which birds may be carried and still remain capable of homing; (2) to ascertain whether the birds show differences in their homing abilities, when they are taken in different directions; (3) to examine the possible influence of terrestrial magnetism on homing.

We succeeded in catching in Butyny near Lwów twelve adult birds. Thanks to the help of Polish Airways "LOT", as well as to the co-operation of naturalists in Finland, Estonia, Germany and Portugal, the storks

have been taken: to Lisbon (2,700 km. to the west; maximal distance in air-line); to Berlin (680 km. to the west; problem of magnetism and of the west direction); and to Harviala in Finland (1,132 km. to the north; problem of magnetism and of the north direction).

Each of these three groups was composed of four birds, specially marked with bright colours and rings, so as to be easily recognized on return to their nests in Butyny. Besides that, after long preliminary experiments we succeeded in fastening magnets to the heads of three birds of each group destined for Germany and Finland. The magnetic fields of the magnets were calculated according to the formula of Gauss. They were several times stronger than the magnetic field of the earth, which would mean, according to Stresemann's hypothesis, that they ought to eliminate its influence.

Our experiments did not give quite satisfactory results. That was partly due to difficulties in obtaining a larger amount of experimental material, and also to very unfavourable meteorological conditions in the second half of June 1938 when the experiments took place.

With regard to the first problem, though the birds behaved in identically the same way as others did in our first experiments in 1937, not one of the four birds of the Portugal group landed home. Of course the maximal distance from home had been exceeded (2,700 km. by air-line in comparison to 2,260 km. of the proceeding year Lydda (Palestine) to Butyny). On the other hand, it is possible that the obstacles caused by the desert-tableland of Spain, the Pyrenees and the Alps were very difficult to overcome, and the air currents, of which storks take generally great advantage, were unfavourable.

In the second experiment, three birds, out of four released near Berlin, came home. Their flight homewards was much slower this time. It varied between 43 and 107 km. daily, in comparison to 165 and 188 km. in the year 1937. It is yet impossible to give a definite decision concerning any influence that the earth's magnetism may exercise on the capacity of homing in birds, because of two control birds without magnets one came home. Yet comparing previous experiments (when birds had mostly been transported to the south, that is, along their usual migration direction) the return of birds of the Berlin group proves that they are capable of homing not only from great distances but also from directions and countries hitherto unknown to them.

The results observed of the transport of birds to Finland are still more striking. In this group three birds had magnets fastened to their foreheads and one bird a control bar, of the same weight. Owing to the fact that storks appear rarely in Finland, and owing also to the help of the members of the Zoological Museum in Helsingfors, we were well informed about the flight of the birds in Finland and partly in the neighbouring countries as well. Not one of the birds came home; two of them perished for unknown reasons. The most interesting fact is that the birds, after having left Harviala, were seen in many parts of the country, mostly on the beach of the 100 km. wide Finland Bay, which lies in between the straight and shortest air-line to Poland. From there they went back to Harviala at different intervals. Most probably the birds found the bay too wide to fly over. (The Straits of Gibraltar, the Bosphorus, Sea of Marmora, their usual routes, are much narrower.) Their return to Harviala proves a curious attachment to a new locality.

Further experiments will be conducted in 1939.

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[1] NATURE, **141**, 35 (1938).

Hypospadias and Non-descent of the Testes caused in Rats by Progesterone

Hain[1], Wiesner[2], Greene and Ivy[3] have reported the occurrence of hypospadias in young female rats following the injection of œstrogens or androgens (œstrone, androstanediol, testosterone) into the pregnant mothers or into the young soon after birth. Lacassagne[4] has observed a similar lesion in a male rabbit treated from birth with œstrone. I also have observed hypospadias in female rats and mice treated from birth with œstrone or testosterone. The males have not shown any malformation of the penis; but their testes have failed to descend into the scrotum at the normal time. In a recent experiment, fifteen new-born Wistar rats were given subcutaneous injections of 0·5 mgm. progesterone in sesame oil on each of the three post-natal days, and 1 mgm. was given three times a week until the twenty-third day, after which no further treatment was applied except that on the forty-fourth day 2 mgm. progesterone were given to each of the males. At this time the eight females all showed hypospadias and the seven males all had undescended testes. On the sixty-fifth day two only of the males have testes in the scrotum. Normally the testes would have descended not later than the fortieth day.

The comparable results obtained by all these three types of gonadal hormones seem to be worth recording.

The progesterone used was most kindly given by the Ciba Company.

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April 26.

[1] Hain, A. M., *Edin. Med. J.*, **42**, 101 (1935).
[2] Wiesner, B. P., *J. Obst. Gynæcol.*, **42**, 8 (1935).
[3] Greene, R. R., and Ivy, A. C., *Science*, **86**, 200 (1937).
[4] Lacassagne, A., "Certain Biological Problems Relating to Cancer, Hormones and Radiation" (1936).

New Data on Spontaneous Mutations

AMONG the factors that are of decisive importance in the development of the individual, but do not influence directly its germ-cells, the nutritive regime must be mentioned in the first place. The purpose we had in view was to study the rapidity of mutation process in *Drosophila melanogaster* under conditions of an avitaminous B_1 regime.

We made use of the line 'white' for investigation. By way of many times repeated transfers of the flies (Guyénot method, 1911) a complete elimination of microflora was achieved and an aseptic line obtained.

Three groups of individuals could be employed for genetical purposes: (1) the control individuals

which developed on a yeast medium (10 days duration of development); (2) individuals that had the vitamin B_2 given them on the twentieth day of their larval life (the flies began to emerge on the thirtieth day after the eggs had been laid); (3) individuals which had fed on yeast medium for a period at the longest of twenty-four hours after hatching and continued their development on an avitaminous B_2 medium (10 days duration of development).

The adults of group (2) did not differ from the controls in regard to duration of life and fertility (males only were studied). But these individuals in the period of their larval life preceding the addition of yeast medium have quite certainly been subjected to a strong and unfavourable effect of an avitaminous B_2 regime (when no yeast medium is added more than 99 per cent of individuals die on the eighteenth to the twenty-second day of their larval life). In adults of group (3) the duration of life and fertility are greatly diminished: the vitamin B_2 not only influences metamorphosis (a minimal amount suffices for securing the setting in of the pupal stage and the emerging of the fly), but the organism as a whole is likewise strongly influenced by it.

The rate of lethal mutations found in the *X*-chromosomes (method *ClB*) of the control ♂♂ ($0{\cdot}21 \pm 0{\cdot}08$) and the ♂♂ of group (2) ($0{\cdot}15 \pm 0{\cdot}07$) is about the same in both cases (difference $= 0{\cdot}06 \pm 0{\cdot}11$). At the same time, if the number of originated mutations corresponded to the time elapsed, the percentage of mutation brought into evidence in the experimental material (duration of development thirty days) should have been three times as large as in the control (10 days duration of development).

The percentage of lethal mutations found in the II chromosomes (method *Cy sp/L*[2]) in experimental ♂♂ of group (2) ($1{\cdot}07 \pm 0{\cdot}16$) is about on a par with the rate of mutations in the II chromosomes in the control ($0{\cdot}66 \pm 0{\cdot}13$) or even somewhat lower than the latter (difference $= 0{\cdot}41 \pm 0{\cdot}21$). Statistically the difference between the number of mutations found in II chromosomes of group (2) and the number of mutations to be expected if the rapidity of the mutation process did not depend on the rapidity of individual development is quite real (difference $= 43{\cdot}07 \pm 8{\cdot}30$). The experiment just described contains, moreover, the data indicating that the suggestion of a germinal selection acting in our experiment has no validity: the relation of the percentage of mutations found in ♂♂ of group (2) to that in the control is about the same for the *X* as for the II chromosome.

The question arises whether it is a simple coincidence that the percentage of mutations relative to the number of chromosomes studied proves to be about equal in ♂♂ of group (2) and in control ♂♂. Does not this fact indicate that in ontogenesis forces are acting that occasion accumulation of a certain number of mutations in the individual's germ-cells up to the close of metamorphosis? For the solution of this problem individuals of group (3) were employed (their development as in control group lasts 10 days).

The percentage of lethal mutations found in the II chromosomes in group (3) and in the control group is the same in both cases (difference $= 0{\cdot}01 \pm 0{\cdot}43$). Thus we may consider it as proved that the decrease in rapidity in the mutation process, brought into evidence in the preceding experiments in which ♂♂ of group (2) were studied, is due to the fact that in this group the development is of longer duration. The decisive role may quite possibly belong here to a slowing down of the process of spermatogenesis, or more exactly, in connexion with the latter, a slowing down of the rate of reproduction ('multiplication') of the genes.

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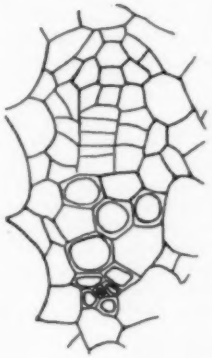
Leningrad.
April 5.

Centripetal Xylem in the Pedicel of a Monocotyledon

THE centripetal xylem in the stem among the vascular plants is confined to the Pteridophyta and lower gymnosperms, the Pteridospermæ and the Cordaitales. The vegetative stem of Cycadales and Coniferales lacks centripetal xylem; but it occurs in a poorly developed condition in certain conservative regions like the reproductive axes and the leaf traces. In the Gnetales and the angiosperms the axial organs show exclusively the endarch condition, and the centripetal xylem is altogether absent from the primary vascular bundles.



In my study of the floral anatomy of *Gagea fascicularis* Salisb., however, I have seen distinct traces of centripetal xylem in the vascular bundles of the pedicel. The pedicel in this species at its distal end shows six bundles. Three of these are large and three alternating are small. The smaller bundles frequently show in addition to the normal centrifugal xylem one or two vessels to the inside of the first-formed narrow protoxylem elements. The structure is shown by the accompanying figure. Details will be published elsewhere.

The structure of the vascular bundles in the flowers of *Gagea fascicularis* is also interesting in showing a distinct intrafascicular cambium.

A. C. JOSHI.

Benares Hindu University.
April 1.

Ethmoplax, a New Name for *Stratiphyllum* Smyth

AT a meeting of the Royal Irish Academy held on May 8, 1933, I proposed the name *Stratiphyllum* (as *Stratophyllum*) for a Carboniferous tabulate coral from Tournai, Belgium. The name was not published until September 8 of that year[1]. Dr. Stanley Smith has directed my attention to the fact that in the meantime Dr. Walther Scheffen had published the same generic name for some Silurian rugose corals from Norway[2].

I therefore wish to rename the Tournaisian form *Ethmoplax* (ἠθμός, a strainer; πλάξ, anything flat and broad, a plain).

LOUIS B. SMYTH.

Trinity College,
Dublin. April 27.

[1] *Proc. Roy. Irish Acad.*, **41**, Sect. B, 13, 171 (1933).
[2] *Skrift. Norske Vidensk.-Akad. Oslo* (1932), *I, Mat.-Naturvid. Klasse*, **2**, No. 5, 35 (May 1933).

Kinetochore or Centromere?

IN his recent communication[1], Dr. Mather seems to have no argument against the applicability of 'kinetochore'. He sponsors 'centromere' largely because it is used by a number of investigators. But I, for one, am not convinced that it is the "best term in use to-day". To Dr. Mather 'centromere' may imply a visible particle, but to many it will connote a part that is centrally placed in a topographical sense. No such meaning is of course intended. My advice concerning the confusion that may arise from the addition of still another to the series of words involving 'centre' rests on my experience as a teacher. Perhaps the validity of such advice will be more apparent if I point out that in 1936 Darlington[2] himself used 'centrosome' when he evidently meant 'centriole'. The argument that no such confusion has attended the use of a series of terms involving 'chroma' is not well chosen, for in one place in the same paper (p. 266) Darlington writes 'chromosome' when he means 'chromomere'.

So far as priority is concerned there seems little room for argument. Sharp proposed the term 'kinetochore' in 1934. Nebel[3] adopted it in 1935 and I myself[4] first used it in June 1936. Darlington[5], in 1935, was still using "spindle attachment chromomere" and, if I am not mistaken, it was not until December 1936, six months after my publication, that he employed 'centromere', probably unaware of its previous use in a different sense by Waldeyer. He made no reference at all to 'kinetochore' which, as I have said, does not carry the disadvantages of the term sponsored by himself.

I suggest that we submit the matter to the proper committee at the coming Congress of Genetics at Edinburgh. I, for one, should be quite willing to accept its decision.

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April 4.

[1] Mather, K., NATURE, **143**, 289 (1939).
[2] Darlington, C. D., *Proc. Roy. Soc.*, B, **121**, 264 (1936).
[3] Nebel, B. R., *Zuechter*, **7**, 132 (1935).
[4] Schrader, F., *Biol. Bull.*, **70**, 484 (1936).
[5] Darlington, C. D., *Proc. Roy. Soc.*, B, **118**, 33 (1935).

Points from Foregoing Letters

J. ROTBLAT compares the increase in the neutron effect obtained by means of uranium with that produced by aluminium and copper, and concludes that v. Halban, Joliot and Kowarski are correct in ascribing the uranium effect to the increase in the number of neutrons resulting from the fission of uranium nuclei, rather than to the simple reaction $(n,2n)$.

O. R. Frisch compares the radioactive decay curve of the uranium fission products with a calculated curve, the calculation being based on simple statistical assumptions about the distribution of decay periods. The good agreement indicates that the individual features of the decay curves are very nearly eliminated on account of the large number of decay periods.

J. Ashmead has measured the specific heats of copper sulphate and copper potassium sulphate below 1° K. The curve for copper potassium sulphate has only a maximum due to magnetic interaction, but copper sulphate has also a maximum at higher temperatures. This indicates that there may be a contribution to the specific heat from Stark splitting even when the orbital momentum would normally be considered quenched, leaving the ion in an ^2S state.

The minimum sparking potential of deuterium is found by F. Llewellyn Jones to be strongly characteristic of the cathode material, and is about 3 per cent greater than that of hydrogen. At higher pressures the sparking potentials are identical.

G. Stenvinkel states that the emission spectrum of AlH from an electric furnace shows that AlH is formed in an activated electronic state. This formation is a function of the time. There are several anomalies in the intensity relations of this band spectrum.

D. van Dantzig considers that the particle density of a chemically homogeneous, relativistically perfect fluid cannot be calculated from the stress tensor, as it depends upon the temperature also. For an ideal gas the relations between these quantities can be determined explicitly. This is done to a second approximation.

A. Eagle suggests that the whole system of extragalactic nebulæ may not be retreating from the galaxy but revolving about it; the displacement of the spectrum lines being due to a change of period of vibration due to the velocity.

E. L. Hirst, J. K. N. Jones and Miss W. O. Jones show that the polysaccharide alginic acid, which is an important constituent of certain seaweeds, can be transformed into a less viscous form of low molecular weight. A major feature of the structure of alginic acid is a chain of *d*-mannuronic acid residues linked together by glycosidic links connecting the 1 : 4 positions. This structure is compared with that of cellulose and that of pectic acid.

Further experiments on homing in white storks, carried out by K. Wodzicki, Wł. Puchalski and H. Liche, attempted to examine the influence of the magnetic field of the earth and the reactions of birds taken in different directions.

The three main types of gonadal hormone will produce in some circumstances a similar biological effect. A new example is recorded by H. Burrows, who finds that, given to rats on the day of birth and afterwards, progesterone, like œstrone or testosterone, will cause hypospadias in females and delayed descent of the testes in males.

J. M. OLENOV states that the percentage of lethal mutations found in the *X* and also in the II chromosomes in *Drosophila melanogaster* individuals that had vitamin B_2 withheld until the twentieth day of their larval life is about the same as in the control group. If the number of induced mutations corresponded to the time elapsed, the percentage of mutations brought into evidence in the experimental group (duration of development thirty days) should have been three times as large as in the control (duration of development ten days). The decrease in rapidity in the mutation process may be due to a slowing down of the process of spermatogenesis.

Research Items

Origin and Physical Qualities of the Minoan Shield

THE peculiar shields represented on seal stones, etc., of the Middle and Late phases of the Minoan bronze age culture have been repeatedly discussed, especially since they were claimed by Wolfgang Reichel as the type described in the Homeric poems. The construction of this kind of shield and its connexion with certain other shields is discussed on strictly archæological evidence by Prof. J. L. Myres in *Man* of March 1939, while Prof. A. E. H. Love considers its shape and physical qualities. The famous Lion Hunt inlaid bronze dagger from Mycenæ shows two types of shield: (*a*) a rectangular shield, and (*b*) the 'figure of eight' shield. The former is also seen in side view as an upright semi-cylinder—the 'tower shield'. Both were worn suspended by a strap from the left shoulder, either in front or behind, leaving both hands free. The shields are recognizably of ox-hide, and were flexible. They were stiffened around the margin by a metal rim or reinforcement of leather, affixed with stitches or rivets. Nothing quite like these Minoan shields is known from neighbouring cultures. They were evolved, not from the Egyptian parrying shield, but from some such protective wrapping as that shown on a fragmentary vase of silver from Mycenæ, where the fighting men wear a loose body protection slung over the shoulder and hanging to the knees. The elaboration of this protection was in two directions: (*a*) if the ox-hide were stiff enough, it could be bent permanently into a half-cylinder, resulting in the 'tower shield', or (*b*) if a lighter and more flexible hide were used, it buckled with its own weight, but the buckling was utilized to produce the 'figure of eight' shield, with its peculiar combination of rigidity along the two lines of folding and elasticity elsewhere, increasing towards the margin. When manipulated in action by the two hands exerting pressure at the point of rigidity and suspension, it assumed the 'figure of eight' shape, essentially two obtuse cones intersecting along the two halves of the original fold, which Prof. Love suggests are the stiffest of the generators of such cones.

Individual Interests and Vocational Adjustment

J. G. W. DAVIES has recently published an account of the place of interests in vocational adjustment (*Occup. Psych.*, **13**, No. 1). Vocational adjustment is satisfactory when a person's occupation provides a sufficient outlet for his abilities, interests and disposition characteristics. The degree of vocational adjustment is infinitely varied, and most people occupy a position near the mean, but the standards of the mean might be raised by scientific vocational guidance. Most people desire an interest in their job, therefore it is important to discover if there is any kind of general stability in the interests of children from pre-adolescent years to maturity. There is some evidence suggesting that several important interests can be expected to remain permanent. The author divides interests into three main categories, intellectual, practical and social, and using the genetic method he shows what kind of pursuits would be followed in childhood by people whose dominating interests are in one or other category. Then, presupposing that anyone who is in one of these groups will in adult life continue to have the same interests, he shows the types of occupations most likely to satisfy him. It is, of course, necessary to discriminate between interest and ability, and also to understand the motives that lie behind certain ambitions. Some light is thrown on the major mental mechanisms and emotional disturbances which must be considered in order to give appropriate weight to the enthusiasm of adolescent decisions regarding vocation. The article shows how advice, founded on scientific insight, can be used to prevent unnecessary vocational maladjustment, and can give some guiding principles to be observed in making a wise choice.

Fibrillary Contractions Produced by Physostigmine

J. Szelöczey and J. Horváth (*Magyar Orvosi Archiv*, **39**, 671; 1938) have found that intravenous injection in rabbits and intraperitoneal injection in rats of 0·37 mgm. physostigmine per kgm. of body weight produced fibrillary contractions lasting thirty minutes. Neither atropine nor calcium stopped the contractions, but only weakened them for a short time. Previous administration in rats of a nearly lethal dose of atropine might prevent occurrence of the contractions. No relationship was observed in the rabbits between the strength of the contractions and the calcium content of the blood. Potassium chloride did not increase either the duration or the strength of the contractions in rabbits. These findings show that the fibrillary contractions produced by physostigmine are not the result of any conservation of acetylcholine, but are manifestations of the specific effect of the drug.

Scyphozoa of the Red Sea

THE Scyphozoa of the Red Sea have recently been critically described by G. Stiasny (*Verh. Konin. Nederland. Akad. Wetens. Amsterdam*, 1938). The author has already published an account of the specimens of this group collected by the John Murray Expedition. Since then the examination of further material from the Red Sea and from the museums of Leyden, Paris and London has made possible a more comprehensive study of the forms from that area which, up to now, have not been well known. No representatives of the Cubomedusæ or Stauromedusæ are recorded. Four species of the Semæostomeæ are described, and in addition two specimens of a form that is obviously congeneric with *Cyanea* but does not allow of specific identification. Similarly, in addition to the eight members of the Rhizostomæ there is also an unidentified species of *Mastigias*. The author adds a note on the prevailing winds and currents of this interesting sea.

A New Parasitic Slime-Fungus

G. A. LEDINGHAM has recently issued an account of a new member of the Plasmodiophorales which has been found parasitizing the roots of wheat in

Ontario (*Canadian J. Res.*, **17**; 1939). In addition to spore clusters, large, septate zoosporangia are present with conspicuous tubes for zoospore discharge. In the development of resting spores, naked multinucleate myxamœbæ develop first, then segment to form spore clusters. All zoospores have two flagella of unequal length. The somatic nuclear divisions are characterized by the simultaneous division of both nucleolus and chromatin within a persistent nuclear membrane; prior to the segmentation of the myxamœbæ to form spore clusters and in all divisions during growth of the zoosporangia, the nucleoli and nuclear membranes disappear, and the divisions are of the ordinary mitotic type. Since the zoosporangial characters of this fungus differ from those of other genera in the order, it is suggested that it be placed in a new genus, and the binomial *Polymyxa graminis* is proposed.

Colchicine in the Production of Polyploid Plants

THE discovery by Blakeslee and Avery of the value of colchicine as an agent for the production of polyploids in plants has stimulated investigations by a large number of workers in various parts of the world. The practical possibilities for the plant breeder have made it desirable for a review of all available information. J. L. Fyfe, of the School of Agriculture, Cambridge, has issued a report on the subject (Imperial Bureau of Plant Breeding and Genetics 576.356.5 : 581.04). A description of the different types of polyploids is given and the ways in which they arise. The value of a not too laborious method for their production is stressed. The chemical formula of colchicine differs from other alkaloids in having no heterocyclic ring, its nitrogen atom being in a side chain. It has been recognized for some time as a specific for gout, but its action on mitosis has been appreciated only recently. A number of accounts of the influence on mitosis have been offered, but that of Levan is detailed as being the clearest. Colchicine inactivates the spindle mechanism, prevents anaphase separation of the daughter chromosomes, and this leads to doubling. This doubling may be repeated several times. Influence on meiosis is also discussed and the way in which it differs from that on mitosis. Methods of application vary from that of soaking the seed to painting of shoots or spraying of flowers. Dilutions used vary from 1·6 per cent to 0·02 per cent, according to the technique employed. Experimenters often give scanty details, and methods of identifying polyploidy do not always render results convincing. The only concrete achievement reported is that of the production of a tetraploid *Zinnia*. The review ends with an account of acenaphthene as a substitute for colchicine.

Flower Colour in the Sweet Pea

G. H. Beale, G. M. Robinson, Sir Robert Robinson and R. Scott-Moncrieff (*J. Genetics*, **37**, 375; 1939) give the results of a combined genetical and chemical analysis of *Lathyrus odoratus*. Purple flowers are *E Sm* or *E sm* in constitution while red flowers are *e Sm* and salmon flowers are *e sm*. Chemically, *e* and *sm* control the state of oxidation of the anthocyanin molecule; purple flowers contain derivatives of delphinidin, red flowers contain cyanidin and salmon flowers contain pelargonidin. The gene *d* for dullness exerts its blueing effect on flower colour by raising the *p*H of the cell sap and does not, as formerly supposed, affect the methylation of the anthocyanin. There are at least seven genes concerned in the quantity produced of anthoxanthins and anthocyanins; but it is interesting to note that the type of anthoxanthin does not change no matter whether the anthocyanin is delphinidin, cyanidin or pelargonidin in type. The leuco-anthocyanins of the seed react in accordance with the anthocyanins of the flower to changes in the genetical constitution.

Mycorrhizal Fungi

E. J. BUTLER has investigated the distribution and morphological characters of the vesicular-arbuscular mycorrhizal fungi (*Trans. Brit. Mycol. Soc.*, **22**, Pts. 3 and 4, 274, Feb. 1939). The chief characteristic of this group of organisms is the production of bladder-like vesicles, the arbuscular-sporangiolar apparatus, within the roots of their host plants. These vesicles are apparently concerned with the accumulation of fatty material and its transfer to the plant. Accessory nutrients may also be stored therein. The fungi concerned are closely related to the Endogonaceæ, and the generic name *Rhizophagus* is considered to be the first legitimate name applied to a member of the group, which is thought to consist of a number of allied species in this genus. The species are widely distributed in the soil, and can probably form mycorrhizal associations with most plants.

Comet Notes

NEW orbits of comet Kozik-Peltier have been computed, using observations over nearly a month, and it is now established that it is a long-period comet, the eccentricity being about 0·995. Mr. Przybylski has undertaken the work of computing a definitive orbit of this comet. J. G. Porter and A. E. Levin used Cowell's method for the computation of the perturbations of comet Pons-Winnecke during two revolutions, 1927–33 and 1933–39, and published the results of their work in "Handbook of the British Astronomical Association" for 1939. From the new orbit and ephemeris, Jeffers, at Harvard, rediscovered the comet on March 17, very close to its predicted position. It was diffuse, with central condensation, magnitude 17. The assumed date of perihelion passage was June 23·5042d, and the observation shows that a correction of — 0·76 day gives practically exact agreement with the ephemeris. The comet will make its closest approach to the earth about July 3 and it will be then 10 million miles away. On March 14·9215d U.T., the comet Väisälä (1939 *b*) was observed at Turku by Väisälä, its position being R.A. 9h 37·1m, Dec. 23° 07′ (equinox 1939·0), and its magnitude 15. The following orbit has been computed by Oterma and Väisälä, earlier observations of the object, which was at first considered a minor planet, being used:

Epoch	1939 Feb. 9·000 U.T.	
M	352° 35′	
ω	44 22	
Ω	135 30	1950·0
i	11 04	
e	0·62433	
μ	352′·8	

The period is about ten years.

Relations of the Flora and Fauna of Ireland to those of other Countries*

As the most western land of the great Eurasian continent, Ireland is of peculiar interest. It, like Great Britain, stands on the Continental shelf and is surrounded by a mere film of water as compared with the oceanic depths prevailing to the west. Floral and faunal movement has been chiefly east to west. The opposite has been rare, as suggested by such organisms in the British Isles which are restricted in area, and have a range, often discontinuous, which suggest relict rather than insipient distribution. They would appear to be mostly broken-up remnants of past invasions rather than the first colonies of new species destined to push eastward.

The high winter temperature has allowed of the migration northward of plants and animals which elsewhere in Europe are confined to lower latitudes —the Mediterranean region and the Spanish peninsula chiefly. Mixed with these, in Ireland, especially in the west, are a small number of plants and one animal—the freshwater sponge *Heteromeyenia ryder* —which belong to North America. There are many other problems of distribution which give to the flora and fauna of Ireland a special interest.

In spite of the instability of the earth's crust and of climatic conditions in and around the British Isles during recent geological times, the occurrence of various extraneous elements derived from the south and from the west, as well as the absence from the British Isles—one or both—of many widespread Continental types raise interesting questions. The effects of intermittent water barriers must also be considered.

In spite of the generally low level of the British Isles, submergence has been only very partial from, say, the beginning of the Tertiary period, and only in eastern and south-eastern England do Tertiary marine deposits point to the disappearance of that region as a land surface during much of the Eocene, Oligocene and Pliocene periods.

The sea forms a very effective barrier to plant and animal transport, except for winged creatures. Even as seeds, plants cannot travel very far by sea, for the author has shown that the seeds of 786 different British plants sank either at once or within the course of a few days. Transport of seeds by wind is not very successful. Only plumed seeds have at all a high efficiency. Reduction in size in the seeds of Phanerogams has not gone far enough, and winged seeds are not efficacious. The best results are obtained by seeds which combine reduction in size with a plume of hairs such as those of *Typha* and *Epilobium*. Clearly, normal transport by wind may for practical purposes be ruled out except for a few especially efficient seeds and for very narrow barriers.

Transport of seed by animals over sea must be confined to birds. They are, indeed, efficient agents of dispersal, *provided the barriers are not wide*, for digestion in birds is very rapid. Migrating birds have been shown to arrive empty of food and without seeds adhering to their feet or feathers.

Furthermore, success does not follow merely from the surmounting of the barrier. The main difficulty —successful colonization—still confronts the individual.

The flora of Ireland as compared with that of Britain, and of Britain as compared with that of adjoining Continental countries, do not display any undue proportion of those plants which, by having floating seeds, might have arrived by water; or those which, having flying seeds, might have come by air; or those which are eaten but not destroyed by birds, and might, therefore, have arrived through their agency.

The case for terrestrial, and not trans-marine, immigration is greatly strengthened by considerations of the fauna, and thus are we led to looking for land-connexions in order to account for the present peopling by plants and animals of the British Isles.

Land-connexions have existed during a good deal of recent geological time, and the question follows as to the period or periods of immigration. This raises the problem as to how much of the pre-existing flora and fauna was exterminated by the Ice Age and how much survived. Forbes in 1846 concluded that certain groups in Ireland, including the southern or Lusitanian element, survived the Ice Age, while the bulk of present plants and animals owe their presence to terrestrial immigration in post-Glacial time. Forbes also accounted for the comparative paucity of the Irish flora and fauna in relation to those of Britain by the breaking down of the Irish-British land-connexion prior to the severance of Great Britain from the Continent. Though many agree with Forbes, others have expressed divergent opinions—several, such as Stapf and J. R. Mathews, expressing the view that practical extermination took place during the Ice Age.

The crux of the problem rests on whether during the Ice Age there were ice-free areas with reasonable climatic conditions or whether there was a continuous ice sheet. In the later event, complete extermination seems inevitable and post-Glacial immigration must have been vigorous. But there is no evidence of simultaneous glaciation over the whole of Ireland. In fact, evidence is to the contrary. Thus there is no need to postulate complete extermination during the Ice Age. Further support is given by present-day Greenland, which is probably no better now than Ireland was during the Ice Age, and in Greenland there are four hundred flowering plants and ferns and more than 1,500 lower forms of plants. The same refutation of extermination can be made for England.

The present-day Lusitanian flora and fauna are represented on the Continent chiefly in Spain. These reached the southern British Isles by overland dispersal. The American species in Ireland are of the northern American type, and since none of the species occurs in Siberia, presumably followed the shorter Atlantic route via Greenland and Ireland. None of them occurs in Europe south of Ireland. They probably arrived in Ireland during a pre-Glacial epoch. There is a corresponding group of

* Substance of the Hooker Lecture delivered by Dr. J. Lloyd Praeger before the Linnean Society of London on May 11.

European plants in a limited area of north-eastern North America; this clearly represents a similar migration in the opposite direction. These species, both in America and in Ireland, by their very nature could not have migrated across wide stretches of sea. A relatively high land-level may have existed in the late Pliocene, but it must be admitted that the whole matter of these migrations bristles with difficulties.

The flora of Ireland (1100 species of Phanerogams and vascular cryptogams) is only little more than half that of Great Britain. The greater area, range of latitude, and diversity of surface and soil of the latter cannot wholly explain this paucity in flora and fauna of the former. There is little doubt that many of these British species would have invaded Ireland had they been able, but the Irish Sea formed the barrier to western migration, while Britain was still connected by land with the Continent.

There are, too, many interesting, but puzzling cases of discontinuous species in Ireland, occurring only in one or a few bare patches. It is possible that they have been introduced by air from across channel to places unsuited for them. There are, also, certain species more successful in Ireland than in the sister island. The outstanding problems of the Irish flora and fauna are still many and varied, and the study of fossils and of peat can be expected only to reveal part of the story. But research is going on apace.

Medicine in the Renaissance

THE Institute of the History of Medicine at Johns Hopkins University in Baltimore, which is the only one of its kind in the United States of America, was the last creation in 1929 of that remarkable and radiant personality, William Henry Welch. "My ambition," he wrote to Dr. L. W. Weed, dean of the Medical School, in a letter dated November 21, 1927, "is to create a real institute of medical history with a good reference library and a salaried staff, where facilities are offered not only for teaching, but for serious study and research. A 'Lehrstuhl' merely is not enough". The professorship in the history of medicine in the University was originally intended as a retirement chair for Dr. Welch who, however, insisted on the organization of a properly equipped department. He was succeeded by Dr. Henry E. Sigerist, a former director of the Institut für die Geschichte der Medzin at Leipzig, who, with his magnetic personality, relentless energy, and immense erudition, has built up a magnificent institute serving the triple purpose of research, education, and nucleus for medico-historical activities in the country. Supported by a grant from the Rockefeller Foundation, it is situated on the top floor of the William H. Welch Medical Library. Dr. Sigerist is ably assisted by his associates Drs. Owsei Temkin, Ludwig Edelstein, John Rathbone Oliver, and Sandford V. Larkey. Initially designed as a house-organ, to contain papers written by members of the Institute and by others connected with the University, in January 1933 the *Bulletin of the Institute of the History of Medicine* began to appear as a supplement to the *Johns Hopkins Hospital Bulletin*, from 1935 functioning as an independent organ. At the beginning of 1939 it changed its name to "Bulletin of the History of Medicine. Organ of the American Association of the History of Medicine and The Johns Hopkins Institute of the History of Medicine".

So successful was the first Graduate Week in Medical History held at the Institute in April 1938 that a similar course was planned for the week of April 24–29, 1939. While last year's programme dealt with the principles and methods of research and teaching, the subject this year was "Medicine in the Renaissance". The course was attended by thirty-nine medical historians and students of the Renaissance, including Prof. Leicester Bradner, of Brown University; Dr. Iago Galdston, of the New York Academy of Medicine; Prof. Richard H. Shryock, of the University of Pennsylvania; Dr. Kate Campbell-Hurd Mead; Dr. Benjamin Spector; and Dr. Richmond C. Holcomb. Each morning a lecture, illustrated by an exhibit of the most authoritative literature, and followed by a discussion, was given by Dr. Sigerist and by members of his staff, and the afternoons were devoted to informal round-table seminars. The programme was carefully planned so as to leave sufficient time for individual work and for conversation with the director and his associates.

In the opening lecture on April 24, entitled "Economic, Social, and Political Foundations of the Renaissance", Dr. Sigerist described the medieval world as a static world in which man was born into a definite place and function. Everything was dominated by religion. When the new period started, the system of feudalism began gradually to disintegrate. The struggle between the old and the new orders lasted for three centuries, for feudalism in Western Europe was only overthrown by the French Revolution. The Reformation had enormous economic repercussions: it broke the doctrine of the Church that production is for service only and that the idea of profit is sinful. The fifteenth century witnessed a great development in finance and banking, better and shorter ways of traffic were sought, Western Europe was linked with the New Worlds, and navigation proved a great stimulus to science. Everywhere man felt his individuality, which he desired to apply to a definite purpose. The afternoon's seminar was given up to a discussion of "The Concept of the Renaissance". The term "Renaissance" was first used in art by the sixteenth century Italian art critic and painter Giorgio Vasari. Its technical use dates from Jacob Burckhardt's book "Die Kultur der Renaissance in Italien", 1860. In the evening a play was performed at the Baltimore Museum of Art "The Black Dart of Death", adapted by Dr. Larkey from William Bullein's "A Dialogue against the Fever Pestilence", 1564.

The following day's programme included a lecture by Dr. Edelstein on "Ancient Traditions in Medieval and Renaissance Thought", a seminar on "Bibliographic Problems of Renaissance Literature", and an evening meeting of the Cordell Historical Society of the University of Maryland in the chemical hall

which had witnessed the bestowing of honorary degrees on Lafayette and Ephraim McDowell. On April 26, Dr. Sigerist spoke on "Science and Technology in the Renaissance", and to the afternoon's seminar on "Some Biological Problems of the Renaissance" Dr. Larkey contributed an account of the anatomical text-books of the period, while Dr. Temkin discussed the anti-Aristotelian movement. On April 27, Dr. Temkin, lecturing on "The Physician in the Renaissance", attributed the esteem in which he was held not to his efficiency (in contemporary satires he is more freely attacked than the surgeon), but rather to the academic and financial difficulties attending the acquisition of the M.D. in the sixteenth century. Bearing in mind that the average lifetime of a man in those days was not more than fifty years, at the end of his training the young doctor had already spent more than half his life in study. The medieval physician was restricted in his interests, all scientific knowledge being centred in the philosophers and the theologians. With the Renaissance, the physician began to enter the field of mathematics, mineralogy, chemistry, zoology, and literature. The afternoon's seminar dealt with "Diseases prevailing in the Renaissance and their Interpretation". On April 28, Dr. Larkey spoke on "Hygiene and Public Health in the Renaissance", the subject of the afternoon's discussion being "Medical Literature in the Vernacular: English, German, French, Italian". The closing address of the course was delivered by Dr. Alan M. Chesney, dean of the Medical School, who dealt with the early history of the Johns Hopkins Hospital, the fiftieth birthday of which is commemorated this month.

The intellectual fare of the Graduate Week was temptingly seasoned with tea and cocktail parties, dinners and visits to shrines of interest, such as the Tudor and Stuart Club of Johns Hopkins University, with which the name of Revere Osler, Sir William's only son, is inseparably linked.

The following exhibits had been arranged: Leonardo da Vinci; medical books from the Renaissance presses; and recently published literature in medical history.

At the banquet on April 28, Dr. John Rathbone Oliver spoke on "The Oxford of Anthony Wood", and a presentation was made to Dr. Sigerist and to the very efficient and charming machine behind his brain—his secretarial staff.

WALTER BETT.

Soil Mechanics

PROF. KARL VON TERZAGHI delivered the forty-fifth James Forrest Lecture at the Institution of Civil Engineers on May 2, taking as his subject "Soil Mechanics: a New Chapter in Engineering Science".

At the opening of his address, Dr. von Terzaghi contrasted the empirical methods which were in general use until about twenty-five years ago with the much greater reliability which is now obtainable by allowing for the effects of soil movements and pressures. So unsatisfactory to progressive engineers had the old procedure become of ascertaining the bearing capacity of subsoil that concerted action was taken to study the properties and behaviour of soil and to place these on a sound basis in accordance with the laws of mechanics. The new study was designated 'soil mechanics', a name which in 1936 received confirmation when the first International Conference on Soil Mechanics and Foundation Engineering was held at Harvard University in Cambridge, Massachusetts.

Dealing with the first section of his subject, "The Pressure of Earth on Lateral Supports", Dr. von Terzaghi showed that Coulomb's theory, which is the more reliable of the two in use and dates from 1773, was based on several untenable assumptions. The modifications made in the formulæ as now used have arisen from the discovery that the intensity and distribution of earth pressure depend on many more factors than were realized by earlier workers. Dr. von Terzaghi indicated the nature of, and justification for, these modifications.

Passing to the closely related problem of earth pressures involved in the stability of slopes, Dr. Terzaghi showed that the old method was to prescribe that slopes of fills and cuts should be established at angles somewhat smaller than the appropriate angles of repose. Mention was made of what is known as the Swedish method of determining the degree of stability of a slope, which is based on the empirical fact that the profile of the surface of sliding always approaches the form of a circular arc. For masses of earth having little cohesion and subjected to seepage forces, as in the case of an embankment for water storage, the formulæ adduced in recent studies were shown to give satisfactory results. In the case of clays, however, the determination of the shearing resistance is far more difficult and the position at present is still highly controversial.

A submerged body of soil with little cohesion and in a loose state is liable on the least disturbance to behave as a liquid and to flow on a horizontal surface, a phenomenon which is known as 'flow-slide'. Here the condition was shown to be that the material should be loose enough to be capable of reducing to a denser state as a result of the applied deformation. Flow-slide was thus shown to be associated with porosity, and no flow failure can occur unless the volume at this occurrence is less than the initial volume. The necessity, therefore, of specifying that the porosity of water-retaining embankments should be well below the critical value was thus made clear.

The compaction of embankments is an effective means of limiting the amount of settlement, as in the case of fills for road making, and R. R. Proctor has demonstrated that the degree of compaction produced by a given method depends on the moisture content, being greatest for a certain medium water-content, determinable by experiment. These observations have led to fill-construction methods in which moisture-content controls are introduced. In Germany, the compaction of sandy soil by vibration has been brought to a high state of perfection, and it has been found that the greatest compacting effect is

produced when the frequency of the vibrator is equal to the specific vibration of the soil. The same process is also used for comparing the degree of compaction of fills before and after completion.

Dr. von Terzaghi then dealt with the failure of dams due to piping, a subject which is nearly allied, from the point of view of its mechanics, to the stability of slopes subjected to seepage forces. Bligh's empirical rule was faulty in that it was based on the tacit assumption that the critical percolation factor depends only on the grain size of the subsoil. By model dams so constructed that, by Bligh's rule, the critical head should have been the same for all, it was shown by the highly divergent results that the assumption is greatly in error. Dr. von Terzaghi explained how he came to the conclusion that piping can be eliminated by the provision of an inverted filter between the body of the dam and the foundation, and he described such a filter which he has designed for incorporation in a rock-fill dam in Algiers.

The time factor in relation to earth pressures and movements was next discussed. Using a cylinder filled with water and having a perforated piston supported by springs as an illustration, Dr. von Terzaghi pointed to the fact that, when a constant load is applied, the piston can only descend as the water percolates through the interstices in the piston. At first the water pressure supports the load, but it falls off as the descending piston compresses the spring. A similar process occurs in clay when loaded, and the mechanics of it can be expressed, in terms of time, by a partial differential equation of the second degree. This is known as the fundamental equation of the processes of consolidation. The case was quoted of a power-house where, for a supply of water, a well was driven through the clay to water-bearing gravel below. As a result, the time-rate of settlement of the power-house increased alarmingly, and within a few months the corner nearest the well had subsided more than a foot. When the well was closed, the settlement practically ceased. Dr. von Terzaghi pointed to other instances in which the operation of the theory of consolidation is exemplified, and explained that settlements of this nature can now be computed with reasonable accuracy.

University Events

CAMBRIDGE.—Dr. J. D. Cockcroft, lecturer in physics in the University and fellow of St. John's College, has been elected Jacksonian professor of natural philosophy as from October 1 (see also p. 846).

LONDON.—The following representatives have been elected by Convocation to the Senate: *Medicine*, Sir Ernest Graham-Little, M.P.; *Science*, Prof. G. B. Jeffery, Prof. Major Greenwood; *Engineering*, Sir Charles Bressey.

A Keddey Fletcher-Warr studentship, of the value of £300 a year for three years, has been awarded to Dr. Vernon E. Cosslett (Birkbeck College), for research on the application of electron optics to the design of X-ray tubes and to the measurement of X-ray diffraction patterns.

SHEFFIELD.—Alfred Wright, at present research assistant in mining, has been appointed lecturer in mining; J. W. Watson has resigned from his post of assistant lecturer in geography.

Science News a Century Ago

Wells in the London Clay in Essex

IN a paper read to the Geological Society on May 22, 1839, Dr. Mitchell dealt with "The Wells in the Gravel and London Clay in Essex". The greater part of Essex, he said, consists of London Clay. The greatest thickness of the clay is not known, but it probably exceeds 400 ft. Extensive districts are covered by gravel, sand and detritus. In the districts composed of London Clay, no land springs occur and the wells generally penetrate to the bed of sand between the Clay and the chalk. The Clay is of various colours, the lower beds being sometimes red, but it is sometimes blue at the bottom. In the districts where it is thickest, it is often interstratified with two or three beds of sand, but near the site of Fairlop Fair, it was found to consist of 398 ft. of solid clay. Dr. Mitchell gave a list of nineteen wells, selected from a very large number, the deepest being in Foulness Island, 460 ft. Artesian wells have been productive of the greatest benefit in Essex.

Photography with the Aid of Incandescent Coke

IN the *Athenæum* of May 25, 1839, it was said under the heading "Photogenic Drawing", that "Mr. Robert Mallet has communicated to the Royal Irish Academy a notice of the discovery of the property of the light emitted by incandescent coke to blacken photogenic paper; and proposed it as a substitute for solar light, or that from the oxy-hydrogen blow pipe with lime. One of the most important applications of the photogenic process, as yet suggested, is its adaptation to the self-registering of long-continued instrumental observations. . . . Few artificial lights emit enough of the chemical rays to act with certainty on the prepared paper; while those which are known to act well, as the oxy-hydrogen light, are expensive and difficult to manage. A considerable time since, the author discovered that the light emitted by incandescent coke at the 'Twyer' (or aperture by which the blast is admitted) of a cupola or furnace for melting cast iron, contained the chemical rays in abundance; and on lately trying the effect of this light on the prepared paper, he found it was intensely blackened in about forty-five seconds.

Robert Mallet (1810–80), engineer and physicist, was a graduate of Trinity College, Dublin, and was a partner with his father. Among his works was the Fastnet Lighthouse. He was well known for his study of volcanoes and earthquakes. He was elected a fellow of the Royal Society in 1834.

A Criticism of Davy's Safety Lamps

THE *Mechanics' Magazine* of May 25, 1839, published a report of a lecture by Faraday at the Royal Institution on May 10, on "Some General Remarks on Flame". Faraday had referred to Davy's safety lamps, and in its comments on the lecture, the *Mechanics' Magazine* said: "We have no disposition whatever to detract from the merit or brilliancy of Sir H. Davy's discovery as a scientific fact, but the lamp is a poor fragile thing. . . . Thus instead of protecting the light in a strong lantern he (Davy) contented himself with merely placing around it a flimsy tissue of wire, which besides numerous other objections, is, by its gloomy effect, ever tempting the miner to remove it, or to use a better but more dangerous light.

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **208**, 1061–1124, April 3, 1939).

A. GUILLIERMOND and R. GAUTHERET: The so-called reducing power of the chondriosomes towards Janus green.

M. GODCHOT and MLLE. G. CAUQUIL: Application of the Raman effect to the study of some cyclanones.

G. DEDEBANT and P. WEHRLÉ: Turbulent diffusion.

L. GLANGEAUD and MME. Y. BONNICHON: Dynamic causes of the variations of turbidity and of solid deposit in the maritime Garonne and the Gironde in the course of the tides.

A. PROCA: The fundamental length relating to the elementary particles.

J. ROUBAUD-VALETTE: Possibility of constructing the wave equations relating to particles of multiple spin of $\frac{1}{2}(h/2\pi)$.

J. GUASTALLA: Very dilute films of some proteins; attempt to determine the molecular masses. A weighed quantity of protein is deposited on water in a surface manometer, and the film is compressed and its area measured.

J. GILLOD: A new method of stabilization of an electrometer lamp.

B. KWAL: A phenomenon observed with a Rutherford-Geiger tube-counter submitted to relatively strong radiation.

G. BECK and P. HAVAS: Dissymmetry of the rupture of uranium.

MLLE. N. GOLDOWSKI: Solution potential: the case of aluminium in presence of different gases.

P. SÜE: Thermal equilibrium between Nb_2O_4 and H_2O.

Y. DEUX: Isomerization of phenyl-1 vinyl-2 epoxy-1·2 butane in phenylvinylethylacetaldehyde, and dehalogenation of the corresponding iodohydride in phenyl-3 hexene-1 one-4.

O. SACKUR: Action of organo-magnesium derivatives on chloro-1 cyclohexylmethylketone and chloro-1 cyclohexylphenylketone; secondary replacement of chlorine by pinacolic transposition.

MME. P. RAMART-LUCAS: Structure and absorption of hydroxylated colouring matters of triphenylmethane; existence of isomeric forms of hydroxyfuchsones.

MLLE. D. BIQUARD: Contribution to the spectral study of β-tetralone and β-indanone.

J. EKSTEIN: Influence of temperature on the plasticity and the rupture of crystals. A discussion based on the probability of abnormally large displacements of the position of equilibrium of one or more atoms.

J. NOETZLIN: Volcanism and nuclear chemistry. It is suggested that volcanism is due to localized accumulation of neutrons which are enabled to set up nuclear disruption with release of energy much as occurs in the disruption of uranium.

MLLE. M. JOUVENEL-MARCILLAC: Meiosis in *Raphanus sativus*.

G. MANGENOT: Rootlet development and colchicine. Giant cells with single nuclei which are polyploid to a high degree are formed.

R. COMBES and MLLE. M.-T. GERTRUDE: Contribution to the study of the biochemical possibilities of a plant species. Submitting *Veronica Anagallis* to illuminations down to one sixth of normal, to high altitude and to immersion produces changes in its chemical make-up; thus reducing glucides vary from 0·77 to 10·23, soluble nitrogen compounds from 0·15 to 1·44, and so on.

G. DELOFFRE: Wound phenomena of nuclear growth in the lupin.

M. ROSE and J. BERTHELOT: Production of experimental tumours in higher plants by inoculation with the venom of the cobra *Naja tripudians*.

H. DES ABBAYES: Geographical distribution of the lichens *Cladonia alpestris* and *C. rangiferina*, and the true identity of *Lichen giganteus* Bory.

P. REY: Effect of removal of the principal lobe of the hypophysis on the annual cycle of the male sexual cells of *Bufo vulgaris*.

MLLE. S. THÉVENET: Viscosity of solutions of serum albumin in media of different hydrogen ion concentration. Viscosity is a minimum at about the iso-electric point.

A. BOUTARIC and MLLE. M. ROY: Study of the variation of optical activity of protein solutions in alkaline media.

M. FRÈREJACQUE: Presence of *d*-arabitol in *Fistulina hepatica*.

Washington, D.C.

National Academy of Sciences (*Proc.*, **25**, 55–111, Feb. 15, 1939).

E. W. SINNOTT: Growth and differentiation in living plant meristems. Seeds of some of the smaller grasses are made to germinate on moist paper on microscope slides, and the root tips observed under a water-immersion lens. The meristem cells can be observed directly at regular intervals of time. The cells are in regular longitudinal rows, and new walls are generally transverse, tending to join the side wall half-way between the nearest cross-walls. 'Sliding growth' was not observed. Root-hairs are usually early differentiated.

E. D. CHAPPLE: Quantitative analysis of the interaction of individuals. The separate actions of two interacting individuals alternating with their silences or inactions were recorded; an improved apparatus for this purpose is being made.

O. STRUVE, K. WURM and L. G. HENYEY: Astrophysical consequences of metastable levels in hydrogen and helium.

E. B. WILSON and JANE WORCESTER: Resolution of six tests into three general factors.

W. J. CROZIER: Temperature and the critical intensity for response to visual flicker (2).

J. BARDEEN and J. H. VAN VLECK: Expressions for the current in the Bloch approximation of 'tight binding' for metallic electrons.

G. E. HUTCHINSON, E. S. DEEVEY, jun. and ANNE WOLLACK: Oxidation-reduction potentials of lake waters and their ecological significance. Data for some North American lakes suggests that when the water half a metre above the deepest mud has a potential of 0·4 volt, the mud has a *Tanytarsus* fauna; when the potential is below 0·3 volt, a true *Chironomus* fauna is found.

J. F. RITT: Ideals of differential polynomials.

M. READE and E. F. BECKENBACH: Generalizations to space of the Cauchy and Morera theorems.

G. H. PEEBLES: An equivalence theorem for series of orthogonal polynomials.

E. KASNER and J. DE CICCO: Curvature element transformations which preserve integrable fields.

Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

GEOLOGIST in the Geological Survey of Great Britain—The Director, Geological Survey and Museum, Exhibition Road, South Kensington, S.W.7 (May 31).

ASSISTANT LECTURER IN GEOGRAPHY in the University of Manchester—The Registrar (June 5).

SENIOR DEMONSTRATOR IN PHYSIOLOGY in St. Bartholomew's Hospital Medical College—The Dean (June 10).

DEMONSTRATOR IN ZOOLOGY in Bedford College for Women, Regent's Park, N.W.1—The Secretary (June 15).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Reports of the Council and Auditors of the Zoological Society of London for the Year 1938. Pp. 80. (London: Zoological Society of London.) [174

The Training of Teachers and Grants to Intending Teachers. Being a Report of a Committee of Investigation appointed by the Executive of the National Union of Teachers and adopted by the Executive on 3rd March 1939. Pp. xxxi+328. (London: National Union of Teachers.) [184

Report by the Food Council to the President of the Board of Trade for the Year 1938. Pp. iv+32. (London: H.M. Stationery Office.) 6*d*. net. [204

Iron and Steel Institute. Special Report No. 26: First Report on Refractory Materials. Pp. vi+478. (London: Iron and Steel Institute.) [204

Predatory Birds of Great Britain. Prepared on behalf of the British Field Sports Society by Eric Parker; Schedules showing the Protection afforded to the Birds, County by County, prepared by Phyllis Barclay-Smith and Edward Barclay-Smith. Pp. 84. (London: British Field Sports Society.) 2*s*. [214

Ancient Monuments of Great Britain. List of Monuments (to 31st December 1938), prepared by the Commissioners of Works. Pp. 110. (London: H.M. Stationery Office.) 2*s*. net. [214

Other Countries

Smithsonian Institution: Bureau of American Ethnology. Bulletin 120: Basin-Plateau Aboriginal Sociopolitical Groups. By Julian H. Steward. Pp. xii+346+3 plates. (Washington, D.C.: Government Printing Office.) 50 cents. [144

U.S. Department of the Interior: Geological Survey. Bulletin 894: Geology of the Chitina Valley and Adjacent Area, Alaska. By Fred H. Moffit. Pp. iv+138+13 plates. 1.25 dollars. Bulletin 896: Lexicon of Geologic Names of the United States (including Alaska). Compiled by M. Grace Wilmarth. Part 1: A–L. Pp. 1244. Part 2: M–Z. Pp. ii+1245–2396. 2.50 dollars. Bulletin 897-C: Gold Placers of the Fortymile, Eagle and Circle Districts, Alaska. By J. B. Mertie, Jr. (Mineral Resources of Alaska, 1936). Pp. iv+133–261. 20 cents. Bulletin 898-B: Spirit Leveling in Missouri. Part 2: South-Central Missouri, 1896–1937. By J. G. Staack. Pp. xii+133–308. 30 cents. Bulletin 898-C: Spirit Leveling in Missouri. Part 3: East-Central Missouri, 1896–1937. By J. G. Staack. Pp. xiv+309–450. 25 cents. Bulletin 898-D: Spirit Leveling in Missouri. Part 4: Northwestern Missouri, 1896–1937. By J. G. Staack. Pp. xiv+451–580. 25 cents. Bulletin 902: The Brown Iron Ores of Eastern Texas. By Edwin B. Eckel. Pp. vi+157+20 plates. 1 dollar. Bulletin 903: The Nushagak District, Alaska. By J. B. Mertie, Jr. Pp. iv+96+12 plates. 65 cents. Bulletin 904: Geology of the Slana-Tok District, Alaska. By Fred H. Moffit. Pp. iv+54+4 plates. 35 cents. Bulletin 909-A: Geophysical Abstracts 92, January-March 1938. Compiled by W. Ayvazoglou. Pp. ii+50. 10 cents. (Washington, D.C.: Government Printing Office.) [144

U.S. Department of the Interior: Geological Survey. Professional Paper 187: Geology of the Marathon Region, Texas. By Philip B. King. Pp. ix+148+24 plates. 2.50 dollars. Professional Paper 188: The San Juan Country, a Geographic and Geologic Reconnaissance of Southeastern Utah. By Herbert E. Gregory, with Contributions by Malcolm R. Thorpe. Pp. vi+123+26 plates. 60 cents. Professional Paper 189-D: Oligocene Foraminifera from the Choctaw Bluff, Alabama. By Joseph A. Cushman and Winnie McGlamery. (Shorter Contributions to General Geology, 1937.) Pp. ii+103-120+plates 24–28. 10 cents. Professional Paper 189-E: The Force Required to Move Particles on a Stream Bed. By William W. Rubey. (Shorter Contributions to General Geology, 1937.) Pp. ii+121–142. 10 cents. Professional Paper 190: Lower Pliocene Mollusks and Echinoids from the Los Angeles Basin, California, and their Inferred Environment. By W. P. Woodring. Pp. ii+68+9 plates. 30 cents. Professional Paper 193-A: A New Upper Cretaceous Rudistid from the Kemp Clay of Texas. By Lloyd William Stephenson. (Shorter Contributions to General Geology, 1938.) Pp. ii+16+5 plates. 25 cents. (Washington, D.C.: Government Printing Office.) [144

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 801: Surface Water Supply of the United States, 1936. Part 1: North Atlantic Slope Basins. Pp. viii+402. 50 cents. Water-Supply Paper 802: Surface Water Supply of the United States, 1936. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. vi+228. 30 cents. Water-Supply Paper 803: Surface Water Supply of the United States, 1936. Part 3: Ohio River Basin. Pp. vii+453. 50 cents. Water-Supply Paper 805: Surface Water Supply of the United States, 1936. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. vi+288. 45 cents. Water-Supply Paper 815: Surface Water Supply of Hawaii, July 1, 1935, to June 30, 1936. Pp. iv+108. 25 cents. Water-Supply Paper 824: Surface Water Supply of the United States, 1937. Part 4: St. Lawrence River Basin. Pp. iv+150. 25 cents. Water-Supply Paper 830: Surface Water Supply of the United States, 1937. Part 10: The Great Basin. Pp. iv+97. 20 cents. Water-Supply Paper 832: Surface Water Supply of the United States, 1937. Part 12: Pacific Slope Basins in Washington and Upper Columbia River Basin. Pp. v+172. 30 cents. Water-Supply Paper 833: Surface Water Supply of the United States, 1937. Part 13: Snake River Basin. Pp. vi+221. 35 cents. Water-Supply Paper 834: Surface Water Supply of the United States, 1937. Part 14: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. v+188. 30 cents. Water-Supply Paper 837: Inventory of Unpublished Hydrologic Data. By William T. Holland and Clarence S. Jarvis. Pp. 78. 15 cents. Water-Supply Paper 839: Quality of Water of the Rio Grande Basin above Fort Quitman, Texas. Analytical Data by Carl S. Scofield. Pp. ii+204. 30 cents. Water-Supply Paper 840: Water Levels and Artesian Pressure in Observation Wells in the United States in 1937. Prepared under the direction of O. E. Meinzer and L. K. Wenzel. Pp. iv+657. 1 dollar. (Washington, D.C.: Government Printing Office.) [144

Carnegie Institution of Washington: Department of Terrestrial Magnetism. List of Publications for the Year 1938. Pp. 12. (Washington, D.C.: Carnegie Institution.) [144

Advisory Committee on Education. Staff Study No. 8: Vocational Education. By John Dale Russell and associates. Pp. x+324. (Washington, D.C.: Government Printing Office.) 40 cents. [144

Proceedings of the U.S. National Museum. Vol. 85, No. 3040: On some Species of Chinese Earthworms, with Special Reference to Specimens collected in Szechwan by Dr. D. C. Graham. By G. E. Gates. Pp. 405–508. Vol. 86, No. 3050: Notes on the Birds of Tennessee. By Alexander Wetmore. Pp. 175–244. (Washington, D.C.: Government Printing Office.) [144

Stanford University Publications, University Series. Biological Sciences, Vol. 6, No. 4: The Effect of Different Percentages of Protein in the Diet of Six Generations of Rats. By James Rollin Slonaker. Pp. 68. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press.) 1 dollar. [144

Survey of India. Professional Paper No. 28: The Readjustment of the Indian Triangulation. By Major G. Bomford. Pp. viii+109+13 plates. (Dehra Dun: Survey of India.) 4.8 rupees; 7*s*. 6*d*. [174

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 26: The Progress of Agricultural Science in India during the past Twenty-five Years. By Dr. W. Burns. Pp. ii+49. (Delhi: Manager of Publications.) 1.8 rupees; 2*s*. 3*d*. [174

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 47: The Effect of Employing Different Speeds in the Draw-Frame on the Quality of Yarn. By V. V. Gupte and Dr. Nazir Ahmad. Pp. ii+18. (Bombay: Indian Central Cotton Committee,) 8 annas. [174

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 21, No. 7 (Mathematics, No. 35): Beiträge zur Geometrie der Kreise und Kugeln, 27. Von Sôzi Matumura. Pp. 177–252. (Taihoku: Taihoku Imperial University.) [174

University of Toronto Studies. Applied Mathematics Series, No. 3: An Outline of the Theory of the Allowed Cone of Cosmic Radiation. By M. S. Vallarta. Pp. 56. (Toronto: University of Toronto Press; London: Oxford University Press.) 7*s*. net. [174

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 202: A Comparative Test of the Field of F$_1$ Hybrids between Imbred Lines of Maize. By Dr. James Philip. Pp. 6+2 plates. Mills. 15. Bulletin No. 218: Cotton-Breeding Technique as evolved at Giza. By C. H. Brown. Pp. 13+2 plates. P.T. 3. (Cairo: Ministry of Finance.) [184

League of Nations Health Organisation: Technical Commission on Nutrition. Guiding Principles for Studies on the Nutrition of Populations. By Prof. Dr. E. J. Bigwood. (Official No.: C.H. 1401.) Pp. 281. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 6*s*. [204

U.S. Department of the Interior: Office of Education. Leaflet No. 29: Textbook Expenditures in Large City School Systems, 1932, 1934 and 1936. By Lester B. Herlihy. Pp. 8. 5 cents. Vocational Division, Leaflet No. 3: Teaching the Control of Loose Smuts of Wheat and Barley in Vocational Agriculture Classes. Revised edition. Pp. iv+11. 5 cents. (Washington, D.C.: Government Printing Office.) [214

U.S. Department of Agriculture. Circular No. 506: Control of the Corn Earworm on Fordhook Lima Beans in Eastern Virginia. By Loyd W. Brannon. Pp. 15. (Washington, D.C.: Government Printing Office.) 5 cents. [214

Advisory Committee on Education. Staff Study No. 17: Education of Children on Federal Reservations. By Lloyd E. Blanch and William L. Iverson. Pp. xiii+145. (Washington, D.C.: Government Printing Office.) 25 cents. [214

Cornell University: Agricultural Experiment Station. Bulletin 706: Soils in relation to Fruit Growing in New York. Part 13: Seasonal Fluctuations of Soil Moisture in some Important New York Orchard Soil Types. By Damon Boynton and E. F. Savage. Pp. 36. Bulletin 707: An Economic Study of Land Utilization in Wyoming County, New York. By H. R. Kling. Pp. 56. Bulletin 708: Seedstalk and Bulb Development in the Onion (*Allium cepa* L.). By H. C. Thompson and Ora Smith. Pp. 21. Memoir 215: Growth and Development of the Potato as influenced especially by Soil Reaction. By Ora Smith. Pp. 46. Memoir 216: Biochemistry and Biophysics of the Developing Hen's Egg. 3: Influence of Temperature. By Alexis L. Romanoff, Laura L. Smith and Royal A. Sullivan. Pp. 42. Memoir 217: Studies of the Factor in Cod-Liver Oil concerned in the Production of Muscle Dystrophy in certain Herbivora. By George Davis, L. A. Maynard and C. M. McCay. Pp. 28. (Ithaca, N.Y.: Cornell University.) [214